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The Engineer

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The Devonshire Ironworks, Staveley.

Marine Motor Design.

1500 Volt 50-Cycle Rotary Converters.

Two Types of Automatic Railway Couplings.

15-ton Electrically-driven Testing Machine.

PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

1. TUBING COPPER, Solid Drawn.
2. PINS, SPLIT, and SCREWS for WOOD.
3. FILES.

Forms of Tender may be obtained from the Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 29th September, 1922.

T. RYAN,
Director-General.
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City of Cardiff Education COMMITTEE.

THE TECHNICAL COLLEGE.

PRINCIPAL, CHARLES COLES, B.Sc. (Lond.)

DEPARTMENT OF ENGINEERING.

HEAD OF DEPARTMENT, A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.

SESSION 1922-23

Commencing on TUESDAY, 3rd OCTOBER, 1922).

The following COURSES have been arranged for ENGINEERING STUDENTS :—

A Three Years' Course in Mechanical and Marine Engineering, jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for Apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for Students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Forms of application for admission to the Entrance Scholarship Examination, duly completed, must be received by the 19th September.

JOHN J. JACKSON,
Director of Education.
City Hall, Cardiff. 51

UNIVERSITY OF LONDON.

King's College.

FACULTY OF ENGINEERING.

Complete COURSES of STUDY, extending over either three or four years, are arranged in

CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

The four years' course provides, in addition to the academic training, opportunity for practical training in "works."

HEADS OF DEPARTMENTS.

Professor G. COOK, D.Sc., A.M. Inst. C.E., A.M.I. Mech. E., Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E. (Dean), Electrical Engineering.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor G. B. JEFFERY, M.A., D.Sc. }
Professor SAMUEL SMILES, O.B.E., D.Sc., F.I.C., F.R.S. } Chemistry.
Professor A. J. ALLMAND, M.C., D.Sc., F.I.C. }
Professor O. W. RICHARDSON, D.Sc., F.R.S., Physics.
Professor W. T. GORDON, D.Sc., F.R.S.E., Geology

Considerable extensions have been made in the Engineering Department. These include a large additional drawing office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments; and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 5860

The Polytechnic, Regent-street, W. 1.

SCHOOL OF ENGINEERING.

PRESIDENT OF SCHOOL: THE HON. SIR CHARLES PARSONS, K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
HEAD OF DEPARTMENT: ALEX. B. HORNE, O.B.E., B.Sc., (Hon. Eng.), F.R.S. (Edin.), &c.

The DAY DEPARTMENT RE-OPENS on SEPT. 19th. Entrance Examination commences Sept. 12th, at 9.30 o'clock.

Three-year DIPLOMA COURSES in
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING,
CIVIL ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop and Field. Fee £1 Guinea per annum.

The EVENING DEPARTMENT RE-OPENS on SEPT. 25th. Students enrolled from Sept. 13th, 6 to 8.30 p.m.

The Day or Evening Courses are recognised for the Diplomas and Certificates issued by the Institution of Mechanical Engineers in conjunction with the Board of Education.

Detailed prospectus of Day or Evening Department, 2d. post paid, from the DIRECTOR OF EDUCATION. 106

The Polytechnic, Regent-street, W. 1.

A SPECIAL COURSE has been arranged for students taking the Graduateship Examination of the Institution of Mechanical Engineers, the Preliminary Examination of the Institution of Civil Engineers, and the Final Examination of the Institution of Electrical Engineers.

The classes are as follows :—

PURE MATHEMATICS	Friday, 6.30-8.0
ENGLISH	Friday, 8.0-9.30
MECHANICS	Thursday, 6.30-8.0
FRENCH	Thursday, 8.0-9.30
PHYSICS	Wednesday, 6.30-9.0

The syllabus covers all the work in these subjects required for the examinations mentioned.

Fee for the Course £2 2s.

Prospectus, 2d. post paid, from the DIRECTOR OF EDUCATION. 147

PUBLIC NOTICES

Battersea Polytechnic, London, S.W. 11.

Principal: ROBERT H. PICKARD, D.Sc., F.R.S.

ENGINEERING DEPARTMENT.

EVENING CLASSES suitable for Final B.Sc.(Eng.), A.M.I.C.E., A.M.I.M.E., &c., are held in the following SUBJECTS :—

Strength of Materials with Laboratory Testing.
Theory of Structures and Structural Design.
Theory of Machines and Machine Design.
Heat Engines with Laboratory Testing.
Hydraulics with Laboratory Testing.

Students enrolled from September 19th to 22nd.

DAY TECHNICAL COLLEGE.

FULL-TIME COURSES in Mechanical, Civil and Electrical Engineering for B.Sc. (Eng.) Degree, University of London, or College Diploma COMMENCE SEPTEMBER 25th. Entrance examination commences September 19th. Fee: £18 per session. A higher fee will be charged to students not residing in London.

Full particulars of all classes on application to the PRINCIPAL. 166

ENGINEERING AND TECHNICAL OPTICS.

Northampton Polytechnic Institute, ST. JOHN-STREET, LONDON, E.C. 1.

ENGINEERING DAY COLLEGE.

FULL-TIME DAY COURSES in the Theory and Practice of Civil, Mechanical and Electrical Engineering. The Courses in Civil and Mechanical Engineering include specialisation in Automobile and AERONAUTICAL Engineering, and those in Electrical Engineering include specialisation in RADIO-TELEGRAPHY.

A SPECIAL ENTRANCE EXAMINATION is held at the end of September before the commencement of each session. The Course includes periods spent in commercial workshops and extend over four years. They also prepare for the Degree of B.Sc. in Engineering at the University of London. Fees, £15 or £13 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £62 each for the complete course will be offered for competition at the annual entrance examination in September.

OPTICAL ENGINEERING AND TECHNICAL OPTICS.

Full and Part-time Courses in this important department of Applied Science are given in specially equipped laboratories and lecture rooms. The annual entrance examination is held at the end of September.

EVENING TECHNICAL COURSES

in all branches of Mechanical and Electrical Engineering commence on Monday, September 25th, 1922.

The Laboratories, both Mechanical and Electrical, are well equipped with modern apparatus, which, on the Mechanical side, provides for specialisation in Automobile and Aeronautical Engineering, and, on the Electrical side, for specialisation in Alternate and Continuous-current Work, in Radio-Telegraphy and Telephony, and in Electrical Testing.

More complete particulars, together with conditions of entrance, &c., and all information respecting the work of the Institute can be obtained at the Institute or on application to

E. MULLINEUX WALMSLEY, D.Sc.,
Principal.
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SITUATIONS OPEN

BOLCKOW, VAUGHAN and CO., Limited, Invite APPLICATIONS for the POST of COMMERCIAL MANAGER; only first-class men, with Iron and Steel Trade Experience, will be considered. All applications will be treated in the strictest confidence.—Communications, marked "Private and Confidential," to be sent to G. SCOBY-SMITH, Esq., C.B.E., c.o. Bolckow, Vaughan and Co., Ltd., Middlesbrough. 191 A

PUBLIC NOTICES

University of Birmingham.

CIVIL ENGINEERING DEPARTMENT.

PROFESSOR: F. C. LEA, D.Sc., M. Inst. C.E., M. Inst. M.E.

COURSES in CIVIL ENGINEERING, including Hydro-electric Engineering, leading to the B.Sc. Degree (exempting from the examinations of the Institution of Civil Engineers), will COMMENCE in OCTOBER.

SPECIAL COURSES are also provided in TOWN-PLANNING and CIVIC DESIGN.

Further particulars can be obtained from the SECRETARY or from the PROFESSOR of CIVIL ENGINEERING. 123

Auckland Harbour Board, New ZEALAND.

TENDERS are INVITED for the SUPPLY and DELIVERY of :—

TWELVE (12) 5-Ton (and alternatively for 3-Ton) Semi-portal Balanced Jib ELECTRIC QUAY CRANES.
FOUR (4) 5-Ton (and alternatively for 3-Ton) Balanced Jib ELECTRIC ROOF CRANES.
SIX (6) 1-Ton ELECTRIC MONO-RAIL CRANES.

Specifications, diagrams and forms of Tender can be obtained at the office of the Board's Agents,

Messrs. W. and A. McArthur, Ltd.,
18/19, Silk-street,
Cripplegate, London, E.C. 2,

on payment of a deposit (returnable) of Two Guineas.

Tenders to reach Auckland by Noon on February 1st, 1923, addressed "The CHAIRMAN, Harbour Board, Auckland, New Zealand." 9098

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 13th September proximo, TENDERS for the SUPPLY of :—

MILD STEEL FLATS.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. This fee will not be returned.

G. E. LILLIE,
Secretary.
79-76, King William-street,
London, E.C. 4,
31st August, 1922. 163

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 282.—COAL-HANDLING PLANT FOR MORWELL POWER STATION AND BRIQUETTING WORKS.

CHARGE.—£2 2s. for the first two copies of Tender form, conditions of contract, specification and drawings complete. These charges will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of £1 1s. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 18th December, 1922.

R. LIDDELOW, Secretary,
State Electricity Commission of Victoria,
60 Melbourne, Victoria, Australia.

PUBLIC NOTICES

CONTRACTS, &c.

Great Southern and Western RAILWAY (IRELAND).

CONTRACTS, 1923.

The Directors of the Great Southern and Western Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for three months, commencing 1st October, 1922 :—

	No. of Form.		No. of Form.
Acid, Sulphuric	5 D	Glass and China Sundries	27B
Asbestos Sheeting, &c.	40	Hardware (Sundry)	17
Baskets	10	India Rubber Goods	9A
Bolts, Nuts, and Rivets	15	Implements, Sundry	21
Brooms and Brushes	13	Iron Tubes and Fittings	29
Brass Fittings for Carriages	18	Leather	12
Do. do. for Water	26A	Locks and Keys	19
Do. do. for Gas	26B	Mats, Fibre	10
Canvas and Sacks	6	Nails	31
Castings, Mall. Iron	11	Packings	40
Coach Screws and Washers	15	Plumbago	41
Colours	2	Rain Water Pipes and Gutters	25
Corks	39	Ropes, Twine, and Flax	4
Crucibles	41	Sewer Pipes, Plaster, &c.	32
Drysalteries	3	Soaps	36
Emery and Glass Cloth, &c.	28	Sponge Cloths	5
Files and Tool Steel	20	Signal Wire Pulleys	11
Fire Bricks and Clay	33	Screws and Split Pins	14
Foundry Requisites	42	Shovels, Spades, &c.	21A
Galvanised Sheets, Buckets, &c.	23	Tin-plates	22
Grates, Stoves, and Fenders	24	Waste	5A
Grindstones	28	Wicks	8
Glass, Sheet, and Plate	27A	Wire, Fence, and Signal	30A
		Wirework	30B

Forms of Tender can be obtained on payment of 1s. each from the Stores Superintendent, General Stores Department, G.S. and W.R., Inchicore, Dublin. Applications for forms by post must be accompanied by postal order. Stamps cannot be accepted. All inquiries for information should be also directed to the Stores Superintendent.

Patterns may be inspected at the General Stores Department on and after the 8th inst., between the hours of 10 a.m. and 4 p.m. (except on Saturdays).

Tenders must be enclosed in the special envelope supplied for the purpose with each schedule, and must be posted so as to be with the undersigned before 10 a.m. on Wednesday, 20th September, 1922.

The Directors will not consider any Tender unless it is furnished on the Company's form, and do not bind themselves to accept the lowest or any Tender.

By Order,
ROBERT CRAWFORD,
Secretary.
Kingsbridge Terminus, Dublin,
September, 1922. 178

New South Wales Government.

MINISTER OF PUBLIC WORKS.

TENDERS are INVITED for the MANUFACTURE, SUPPLY and ERECTION of TWO WATER TURBINES and GENERATORS REQUIRED in connection with Barren Jack Hydro-electric Development.

Specification and drawings can be seen and copied at the office of the Consulting Engineer, 64, Victoria-street, London, S.W. 1, or at the office of the undersigned.

Tenders must be delivered not later than 11 a.m. on Monday, 23rd October, 1922, in sealed envelopes, addressed to—

THE AGENT-GENERAL FOR NEW SOUTH WALES,
Australia House,
Strand, London, W.C. 2.
6th September, 1922. 201

Metropolitan Borough of Woolwich.

ELECTRICITY DEPARTMENT.

DISPOSAL OF ELECTRIC AND STEAM GENERATING PLANT AND OTHER ELECTRIC POWER STATION AUXILIARIES.

The Woolwich Borough Council invite TENDERS for the PURCHASE of STEAM ENGINES, DYNAMOS and ALTERNATORS, BOILERS, FEED PUMPS, FORCE WATER SOFTENER, FEED TANKS, AUXILIARY TANKS, WATER PUMPS, STEAM, FEED and WATER PIPING and other AUXILIARY PLANT now available for disposal, in Lots shown on schedules which may be obtained on application to the Borough Electrical Engineer, 44, Powis-street, Woolwich, S.E. 18.

The Tenders must be on forms supplied, and in strict accordance with the conditions stated.

The Council reserve the right to withhold any lot from sale and to accept any Tender.

Tenders to be sealed and endorsed "Tender for Purchase of Plant," and delivered to me at the Town Hall, Wellington-street, Woolwich, not later than 5 p.m. on Tuesday, the 19th September, 1922.

By Order,
ARTHUR B. BRYCESON,
Town Clerk.
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PUBLIC NOTICES

The South Indian Railway

COMPANY, Limited, are prepared to receive TENDERS for the SUPPLY of—

1. 704 AXLE-BOXES for WAGONS.
2. 36,000 FOG SIGNALS.
3. RIVETS, NUTS and PINS.
4. DRYSALTERIES.

Specifications and forms of Tender will be available on Wednesday, the 13th September, 1922, at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked, "Tenders for Axle-boxes," or as the case may be, must be left with the undersigned not later than Twelve Noon on Wednesday, the 4th October, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications Nos. 1, 2, 3 and 4.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
4th September, 1922. 214

PUBLIC HEALTH ACT, 1875.

Urban District of Ruislip-Northwood, Middlesex.

EXTENSION OF SEWAGE OUTFALL WORKS.

The Urban District Council of Ruislip-Northwood, acting as the Sanitary Authority for the said Urban District, are prepared to receive TENDERS for TWO REVOLVING CIRCULAR DISTRIBUTORS, to be delivered and erected at the Outfall Works, Ruislip. Each Distributor will be 68ft. 6in. clear in diameter.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Monday, the 11th of September, 1922, until Monday, the 18th of September, 1922, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of One Guinea, which deposit will be returned upon receipt of a bona fide Tender, which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract deed, the draft of which may be seen at the offices of the Consulting Engineers when the drawings are inspected.

Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Distributors." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Wednesday, the 27th of September, 1922.

Given under my hand the 1st day of September, 1922.

EDMUND R. ABBOTT,
Clerk to the Urban District Council.

Council Offices,
Northwood, Middlesex. 174

TO AUTOMOBILE ENGINEERS.

The Metropolitan Asylums BOARD invite APPLICATIONS for the APPOINTMENT of SECOND ENGINEER in their Ambulance and Transport Service. Salary £174 per annum, plus Civil Service bonus, which at present is £110. Candidates must be between 25 and 32 years of age, and have had not less than 6 years' experience in workshops of large motor factories. For full particulars and form of application, apply to the CLERK TO THE BOARD, Victoria Embankment, E.C. 4, enclosing stamped addressed foolscap envelope. Applications to be sent in by 10 a.m. on 16th September, 1922. 187

SITUATIONS OPEN

WANTED by a Leading Boiler Insurance Company, additional BOILER INSPECTORS; applicants must be practical Engineers, with a technical training, capable of making accurately dimensioned sketches of all classes of steam boilers, and writing clear reports on conditions; commencing salary, £260 per annum.—Address, 179, The Engineer Office. 179 A

WANTED by Firm of Constructional Engineers, COMPETENT MAN to Take Up POSITION of ESTIMATOR; should be accustomed to deal with Prices and make up Estimates and do Correspondence in connection with same. Applicants should have held the position of head draughtsman, and thoroughly understand Calculations and Designs of Structures. State age and salary expected.—Address, "ESTIMATOR," Wm. Porteous and Co., Advertising Agents, Glasgow. 204 A

WANTED, First-class MACHINE SHOP INSPECTOR; used to Viewing and Examining the Larger Machine Parts of Electrical Machines; only high-grade men with experience in maintaining a high standard of machine shop practice need apply. State age, wages and experience.—Address, 206, The Engineer Office. 206 A

WANTED, GENERAL MANAGER for a New Wet Process Cement Plant in India, now in operation; must also be a capable chemist.—State age, experience, and salary required to MANTED and KNOTT, Ltd., Consulting and Cement Works Engineers, Burnett-avenue, Hull. P5999 A

CHEMIST WANTED, with Technical Knowledge and Working Experience of Animal Gut and Treatment thereof; Mechanical Knowledge and Works Experience an advantage. State qualifications and salary required.—Address, P6028, The Engineer Office. P6028 A

DESIGNER, with Experience of the Plant Used in Chemical, Brewing and Foodstuffs Industries, REQUIRED in the London district. The man to be appointed must be capable of independent work and supply evidence of the originality of thought and thoroughness of treatment of the problems entrusted to him.

A permanent and progressive position for the right man. In applying state salary required.—Address, P6018, The Engineer Office. P6018 A

FACTORY ACCOUNTANT WANTED, with First-class Cost Office Experience, for Eastern Counties.
Address, P6033, The Engineer Office. P6033 A

JUNIOR ASSISTANT REQUIRED for Stressing Details. Shop Experience essential.—Applicants to state full particulars and salary required to Box 316, W. S. Crawford, Ltd., 212, High Holborn, London, W.C. 1. 175 A

LONDON REPRESENTATIVE REQUIRED, Structural Steelwork and Mining Plant; commission only. State terms and experience.—NORTONS (Tividale), Ltd., Hecla Works, Tipton, Staffs. 171 A

MANAGER, STEAM SALES DEPARTMENT, handling Boiler Feed Regulator, Feed and Donkey Pumps; experience and connection essential.—Full particulars and salary required to Steam Department, ASTER ENGINEERING CO., Ltd., Wembley. 165 A

OFFICE ORGANISATION EXPERT.—A Large Engineering Combination REQUIRE for their London office a MALE EXPERT in Control of the Junior Clerical Staff, including 100 typists. The appointment, which is a permanent and progressive one, is open only to those who have achieved results in a similar commercial organisation, and who, while being a strict disciplinarian, can secure the loyal regard of his staff.

Address, stating age, experience and salary required, P6038, The Engineer Office. P6038 A

SITUATIONS OPEN (continued)

REQUIRED by Old-established Engineering Firm in India, JUNIOR ACCOUNTANT for Invoicing Department, under 25 years, single; one with similar experience in an engineering firm in this country preferred.—Write fully, stating age, experience and salary required, J. L., 5/6, care Deacons, Leadenhall-street, E.C. 3. 212 A

REQUIRED for Abroad, to Take Charge of Reconstruction of Wharfs and Jetties, MAN with good experience Concrete Work under and above water, Steel Girder Work, &c., and capable of carrying out Repairs to Stone Breakers, Mixers and Pumps; preferably with knowledge of Portuguese.—Write, giving full particulars and salary required, to "VAPOR," c.o. Streets, 30, Cornhill, E.C. 2. 184 A

CONSTRUCTURAL STEELWORK DRAUGHTSMAN WANTED for temporary work in London; used to Designing and Taking Off Quantities.—Address, P6046, The Engineer Office. P6046 A

DRAUGHTSMAN WANTED for Experimental Work; must have good knowledge of Theory and Practice of Internal Combustion Engines and Machinery generally. Investment will be considered as inducement to engagement.—Address, P6021, The Engineer Office. P6021 A

DRAUGHTSMEN, First-class, WANTED, with good experience Complete Turbine Lay-outs and Details.—Write, with full particulars, experience, salary required, Box 724, Sells' Advertising Offices, Fleet-street, E.C. 4. 200 A

FIRST-CLASS DRAUGHTSMAN WANTED for Structural Works, S.W. London; conversant with L.C.C. requirements; able to take work through, quick and reliable. State age, experience, salary required and when free. Permanency to suitable man.—Address, 169, The Engineer Office. 169 A

MESSRS. DORMAN, LONG and CO., Ltd., Middlesbrough, REQUIRE ONE or TWO capable DRAUGHTSMEN, thoroughly experienced in Designing and Detailing Constructional Steelwork for all kinds of Steel-frame Buildings, &c. Only first-class men need apply.—Letters, stating age, experience and salary required, to be addressed to Manager, Messrs. DORMAN, LONG and CO., Ltd., Constructional Department, Middlesbrough. 194 A

STRUCTURAL DRAUGHTSMAN REQUIRED for Works Department; well up in Detail of Structures, speciality Steel-framed Buildings. State age, experience, salary expected.—Address "DRAUGHTSMAN," Wm. Porteous and Co., Advertising Agents, Glasgow. 205 A

A LARGE PROVINCIAL BREWERY REQUIRES the SERVICES of a FOREMAN MECHANIC, age not over 40; preference given to a man experienced in the Maintenance of Brewery Plant and Locomotives, and competent on machine tools.—Address, giving full particulars of experience and salary expected, 203, The Engineer Office. 203 A

SITUATIONS WANTED

AS ASSISTANT WORKS MANAGER or HEAD FOREMAN, Mechanical Engineer of proved ability with extensive experience in general engineering, machine tools, toolmaking, &c., expert on modern speeds and feeds, and thoroughly conversant with latest production methods; maximum output guaranteed, good organiser, disciplinarian; moderate salary.—Address, P6040, The Engineer Office. P6040 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-st., E.C. 202 B

CIVIL ENGINEER (B.Eng., Hons., Liverpool), with two years' colonial experience (P.W.D.), REQUIRES POST, either private firm or public body, with good prospects.—Address, P5999, The Engineer Office. P5999 B

COMPETENT MECHANICAL ENGINEER FREE SHORTLY for RESPONSIBLE POST AT HOME OR ABROAD.

Age 36, Graduate in Engineering with Double Honours, nearly 18 years' varied shop and Office Experience in Capacities up to MANAGING DIRECTOR OF PRIVATE COMPANY. Thoroughly familiar with Medium and Light Class Work, including Instruments.

Exceptional Record in originating and developing new products. Efficient designer, production organiser and administrator.

A POSITION IS WANTED WHICH WILL PROVIDE SCOPE AND REWARD FOR ABILITY AND HARD WORK.

Fullest particulars and references on application.
Address, P6030, The Engineer Office. P6030 B

ENGINEER is DESIROUS of OFFERING His SERVICES as General Manager or Works Manager to any engineering concern which requires a live, up-to-date man, expert in general machine shop practice and construction, foundry and pattern shop. Commercial and works routine.—Address, 161, The Engineer Office. 161 B

ENGINEER (34) SEEKS CHANGE. Progressive position; works engineer, power station plants, &c.; B. of E. certificate, assistant Lancashire marine work 2 years, loco. 6 years, present sit. 6 years; factory engineer on production, used to control of labour, in. and t.; energetic; home or abroad.—Address, P6024, The Engineer Office. P6024 B

ENGINEERING EMPLOYERS

DESIROUS OF
OBTAINING THE SERVICES OF

EXPERIENCED & QUALIFIED FOREMEN,

having expert knowledge and supervisory abilities, should address 9090, The Engineer Office. 9090 B

ENGINEERING STUDENT (19½), 3 Years' Technical training and subsequent experience in high-class mechanical work, DESIRES PROGRESSIVE SITUATION. Accept small salary for good prospects.—Address, P6019, The Engineer Office. P6019 B

GENERAL and WORKS MANAGER DESIRES CHANGE; only large undertaking entertained; railway, general engineering, steam wagon and motor production experience; used to control of 3000 hands and all departments of large engineering concern; expert organiser, au fait with modern methods of production; proved ability, excellent testimonials.—Address, P6022, The Engineer Office. P6022 B

MACHINE TOOL ENGINEER and Well-known Expert in Turbine Reduction Gearing, who has travelled extensively, Italy, France, Belgium, Switzerland, and all the British Isles, SEEKS POSITION as Representative, Works Manager, or Advt. Manager with responsible firm where his experience would be of use.—Address, P5979, The Engineer Office. P5979 B

MECH. ENGINEER (35), Public School, DESIRES APPOINTMENT with Engineering Firm. Exp. includes construction and repairs, locos, and all railway work, internal combustion engines (all types), rail and road motors, erection and maintenance of workshop plant, general engineering work, works management, &c., in Mesopotamia, India and Argentine; recently returned from latter; knowledge of Spanish. Excellent references.—Address, P5982, The Engineer Office. P5982 B

SITUATIONS WANTED (continued)

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The Meuse Lock on the Meuse-Waal Canal.

By Dr. L. R. WENTHOLT, Engineer in Charge of the Construction of the Meuse-Waal Canal.

No. I.

(1) INTRODUCTION.

THE two most important commercial towns and seaports in the kingdom of the Netherlands are Rotterdam and Amsterdam. The principal highways in Holland are the rivers and canals between the North Sea, the ports of Rotterdam and Amsterdam and the German frontier, viz., the New Waterway, the New Meuse, the Noord, the Merwede, the Waal and Upper Rhine, and the North Sea Canals. Another important highway is that from Antwerp to Dordrecht, where it makes connection with the waterway from Rotterdam to Germany, mentioned above. The Waal is of much more importance than the other two branches into which the Upper Rhine divides near the German frontier, the Lower Rhine and Yssel. The waterway from Antwerp to Dordrecht and the Waal divide Holland into two parts, a north-western and a south-eastern. The north-western part is probably intersected by more canals and navigable rivers than any other part of the world of equal area. The south-eastern part is in this respect not so privileged. Before 1900 the only ship canal of any importance in the southern part of Holland was the South Willems Canal, which can only be used by vessels of 450 metric tons carrying capacity or less, while the river Meuse was navigable for very small ships only. In recent years the Wilhelmina Canal, for vessels of 600 tons, has been made, and at the present time the Wessem-Nederweert Canal for vessels of 600 tons, and the canalisation of a part of the river Meuse between the Belgian frontier and Grave and the Meuse-Waal Canal are in course of construction. By making the Meuse-Waal Canal and canalising the Meuse, communication will be opened up between the river Waal and the southern part of the province of Limburg, which will be a matter of great importance, since South Limburg is the only part of Holland where coal is found. The rivers and canals mentioned above are shown in Fig. 1.

As a heavy and increasing traffic on the Meuse-Waal Canal and on the canalised Meuse is expected, the dimensions of the waterway are to be such that it will be navigable by ships with a carrying capacity of 2000 tons, and the locks are to be long enough for a tug and two ships of that size to enter them simultaneously, the tug and the ships lying behind each other. By the Wessem-Nederweert Canal the canalised Meuse will be brought into connection with the South Willems and the Wilhelmina Canals.

Instead of building the Meuse-Waal Canal it would have been possible to continue the canalisation of the river Meuse below Grave and to improve the connection between the rivers Waal and Meuse near St. Andries. The construction of the Meuse-Waal Canal was, however, preferred for the following reasons :—

(1) The Waal as a highway is much better than the Meuse.

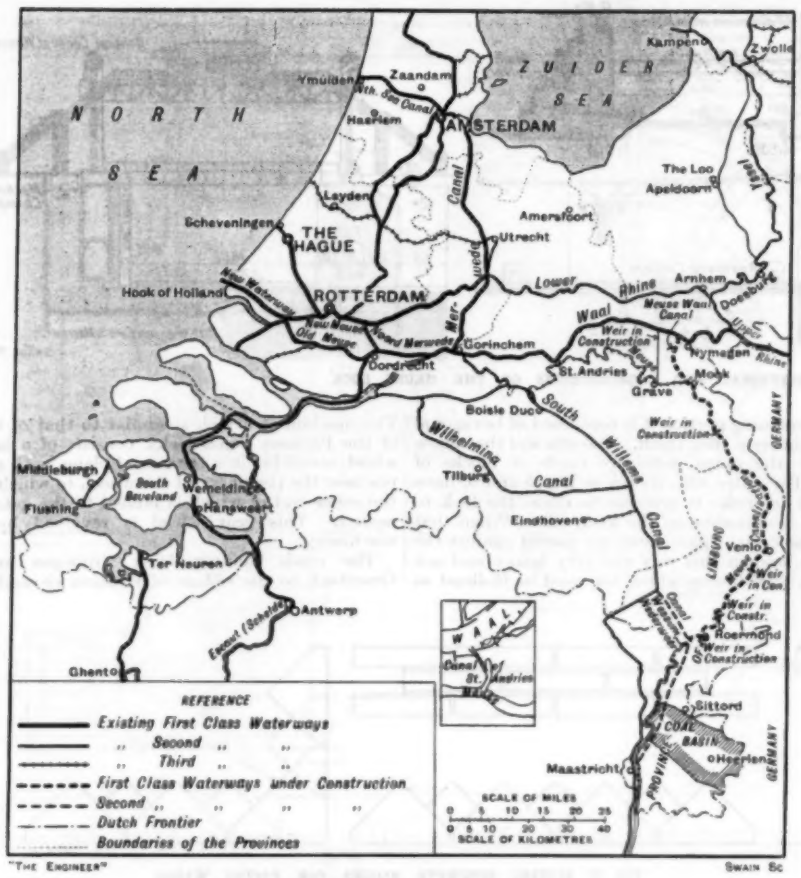


FIG. 1—THE WATERWAYS OF HOLLAND

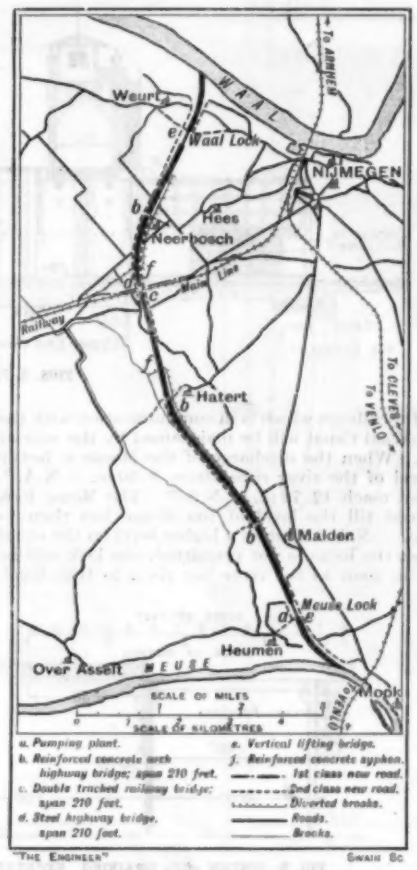


FIG. 2—ROUTE OF MEUSE-WAAL CANAL

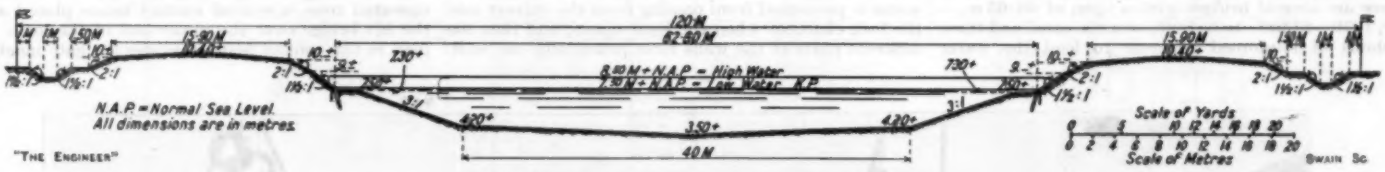


FIG. 3—TYPICAL CROSS-SECTION OF MEUSE-WAAL CANAL

(2) The Meuse-Waal Canal gives a much better communication between the province of Limburg and the eastern and northern parts of Holland and the important town of Nijmegen.

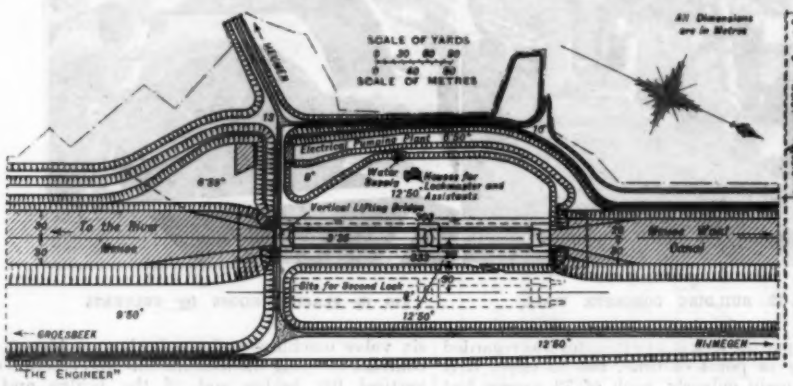


FIG. 4—PLAN OF THE MEUSE LOCK

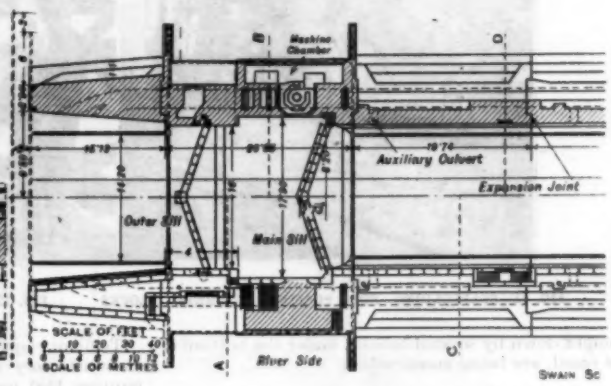


FIG. 5—PLAN OF THE UPPER (MEUSE) END OF THE LOCK

(3) The making of the Meuse-Waal Canal is not so expensive as the canalisation of the Meuse between Grave and Saint Andries and the improvement of the canal and lock of St. Andries would have been.

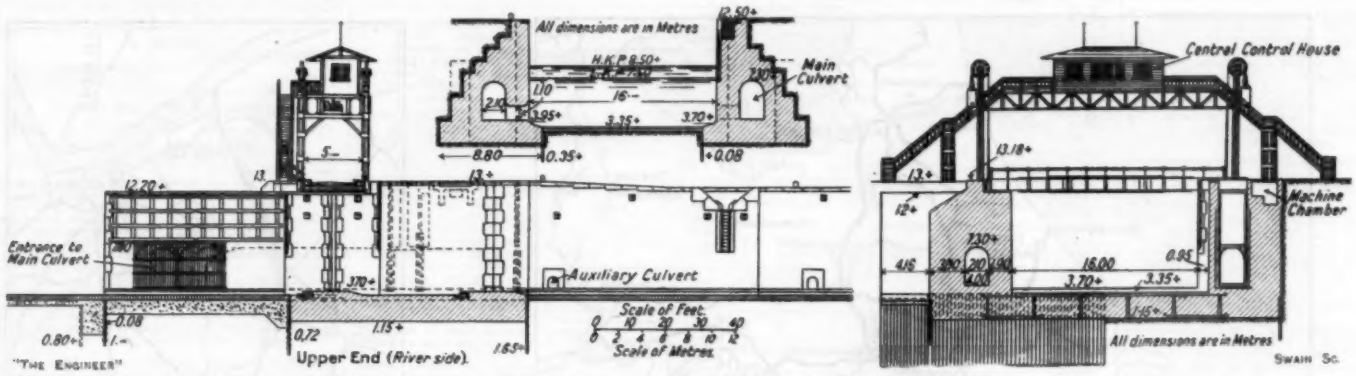
(2) THE MEUSE-WAAL CANAL.

The Meuse-Waal Canal, which is now being con-

structed—shown in plan in Fig. 2 and in section in Fig. 3—is about 8 miles long, 132ft. wide at the bottom, and 200ft. wide at the normal canal level. Its depth is to be from 12ft. to 14ft., and its side slopes are to have a batter of 1 to 3. For several reasons a canal without locks or with only one lock was impracticable, and therefore the canal is being provided with two locks, one near the Meuse and one near the Waal.

As normal canal level (K.P.) 7.50 m. + N.A.P. (normal sea level) was adopted, at which level the lock has intermediate gates, so that a shorter lock chamber can be used if required. A general plan of the lock is shown in Fig. 4, the upper or Meuse end of the lock being shown in plan in Fig. 5, in longitudinal section in Fig. 6, and in cross section in Figs. 7 and 8.

The material through which the canal passes is sand and gravel. It is well suited for the foundation of a heavy structure. Concrete was adopted as the material for the walls. The floor of the lock underneath the gates is of reinforced concrete 7ft. thick. be opened and closed in one minute by chains operated by a winding engine. At each side of each valve is a guard valve, which is only closed when the operating valve is out of commission for any reason, and it is possible to drain the area between the two guard valves and to enter into the part of the culvert thus freed of water. Screens are placed before the culverts to prevent drift wood and ice from entering them. Steel was adopted as the material for the mitre gates, which are mechanically operated, and it was specified that they should be closed and opened in fifty seconds.



FIGS. 6, 7, AND 8—LONGITUDINAL AND CROSS-SECTIONS OF THE MEUSE LOCK

part of the Meuse which is in communication with the Meuse-Waal Canal will be maintained by the weir at Grave. When the discharge of the Meuse is heavy the level of the river rises above 7.50 m. + N.A.P. and can reach 12.70 m. + N.A.P. The Meuse lock is opened till the level of the Meuse has risen to 8.50 m. + N.A.P., but as a higher level on the canal between the locks is not permitted, the lock will be closed as soon as the river has risen to that level. For the remaining portion it is composed of hexagonal blocks of concrete 16in. thick. The sills and the hollow quoins for the mitre gates are made of blocks of granite. The outer sills, shown in Fig. 5 and 6, have been built to make it possible to drain the lock to permit of examination of the main sills. When that becomes necessary spare gates are placed against the outer sills, and in this way the very heavy and not always suitable beams which are used in Holland as The machinery, which is similar to that of the gates of the Panama Canal locks, consists of a large gear wheel, revolving in a horizontal plane, with a vertical pin near the periphery of the wheel, to which a beam, the other end of which is pinned to the gate, is connected. This gear wheel is revolved by special machinery.

The roads running from Nijmegen and from Groesbeek to the village of Heumen crossed the line

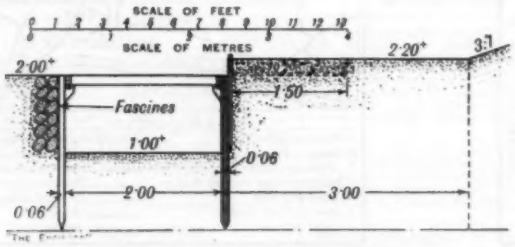


FIG. 9—SYSTEM OF DRAINING EXCAVATIONS

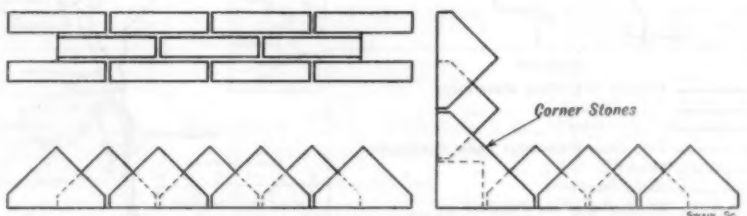


FIG. 10—SPECIAL CONCRETE BLOCKS FOR FACING WALLS

The Waal lock will normally be shut. An electrical pumping plant for the purpose of preventing the water from rising higher than 1 m. above K.P. is being constructed. The combined capacity of the pumps will be such that they will be able to deal with all the water that enters the canal by lockage, leakage and rain. There are several bridges with a span of 60–65 m.—say, 197ft.–213ft.—to be built over the canal and three syphons of reinforced concrete to lead the water a rule to drain the locks, can be dispensed with. The corners of the lock walls where they are exposed to collisions with ships are made of blocks of granite.

To prevent cracking of the walls expansion joints, spaced at intervals of about 70ft., are provided. They have the form shown in Fig. 5, which is such that water is prevented from passing from the culvert into the lock chamber when the joint opens, and that the different parts of the walls form practically one wall. of the canal and provision had to be made to divert them. They are taken over the canal at the upper end of the lock by a vertical lift bridge of 65ft. span.

All the lock machinery is operated electrically. It is contained in chambers below the coping level. The machines for moving the gates and the valves are operated from a central control house placed above the lift bridge over the upper end of the lock. The man in the control house operates six gate machines,

FIG. 11—SCAFFOLDING FOR PLACING CONCRETE BLOCKS FIG. 12—BUILDING CONCRETE WALL FIG. 13—PLACING ROOFS OF CULVERTS

brought down by several brooks, under the bottom of the canal, are being constructed.

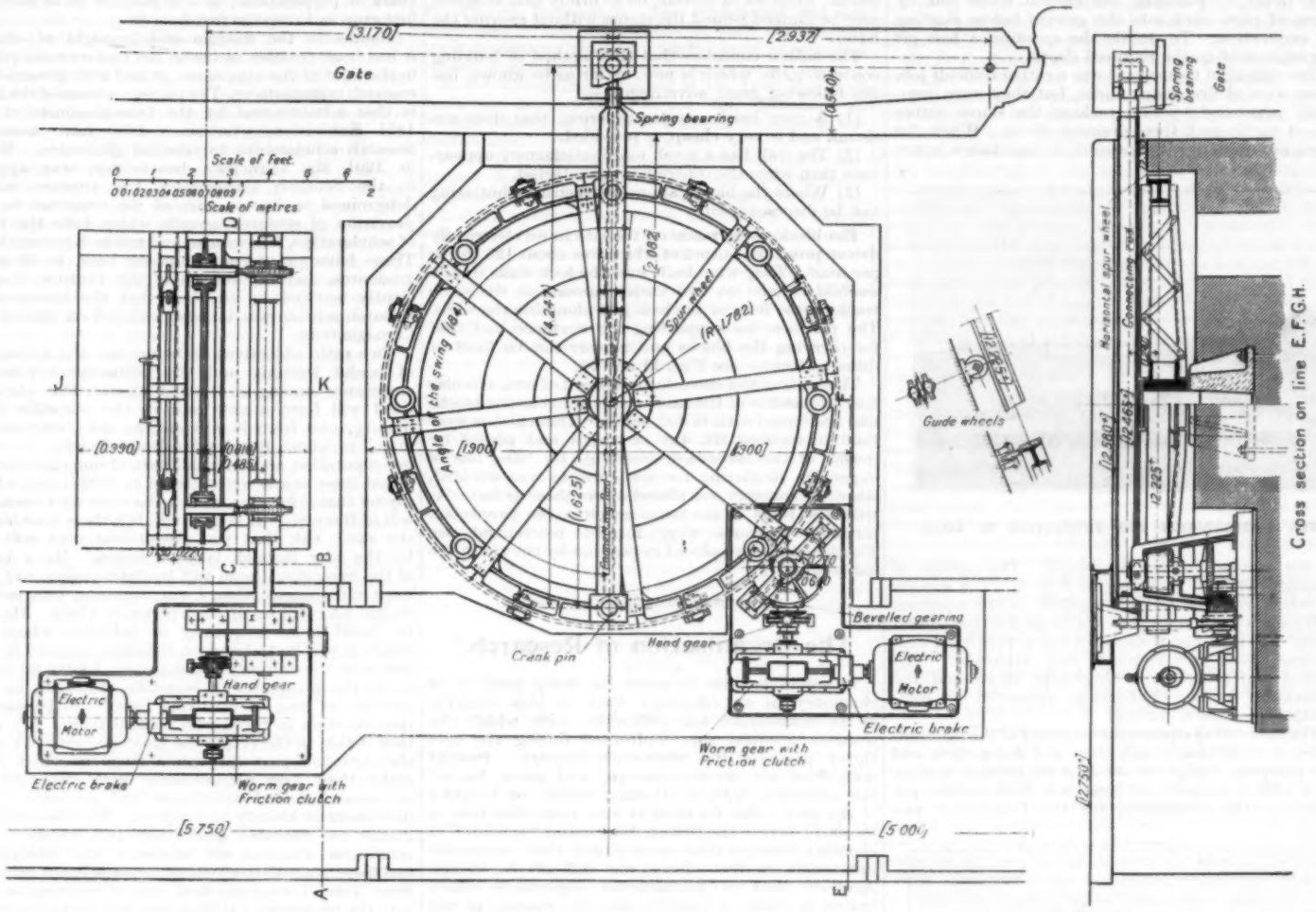
(3) The Design of the Meuse Lock.

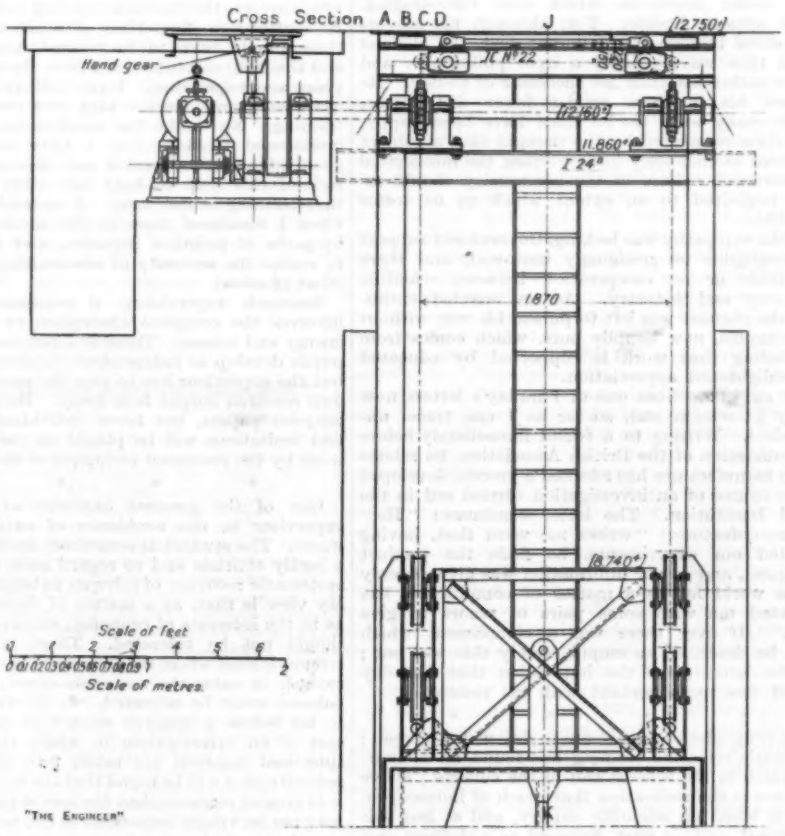
The largest vessels for which the Meuse lock has been built, are of from 2000 to 2400 tons carrying capacity. Such vessels are some 330ft. long by 40ft. beam and they draw 9ft. 3in. of water. The useful length of the lock is 860ft., the total length being about 1100ft., while the width is 52ft. 6in. and the depth on the sills 12ft. 6in. below low water (K.P.). The lift of the lock may vary from 0ft. to 14ft. To fill or empty the lock in five minutes was regarded as satisfactory in point of time, but to effect it it requires two main culverts, each of 72 square feet cross section, extending from one end of the lock to the other. The water is delivered into the lock through twenty-six auxiliary culverts spaced at equal distances apart in the length of its side walls. The main and auxiliary culverts are formed in the lock walls. They are shown in Figs. 5, 6, 7 and 8. The main culverts are closed by vertically moving steel valves at the side of each gate. These valves, which are provided with bearings of polished granite, can six valve machines and the bridge machinery. The contract covering the manufacture and erection of the vertical lift bridge and of the bridge and lock machinery was placed with Figée, Limited, of Haarlem, Holland. The drawings on page 237 show the general arrangement of the lock gate machinery.

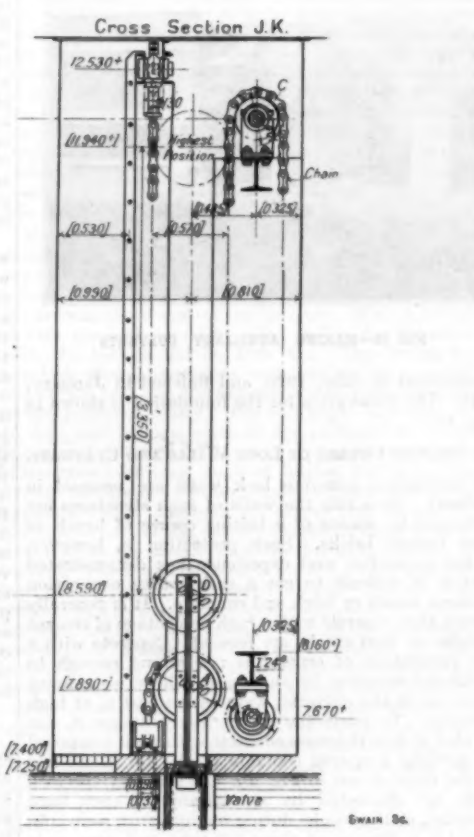
(4) The Foundation Pit.

In the place where the lock is built the soil consists of about 3ft. of hard clay, underneath which come coarse sand and gravel. The elevation of the original surface of the ground was 30ft. above sea level, and

THE GATE MACHINERY OF THE MEUSE LOCK







"THE ENGINEER"

SWAIN Sc.

the ground water level is 28ft. above sea level. The lowest part of the foundation being designed to come at 3ft. 9in. above sea level, the first problem to be solved was whether it would be practicable to make the excavation in the dry, when the only possible means of draining away the water consisted of an open ditch. The more secure, but much more expensive, way would have been to lower the ground water level by pumping the ground water out by means of pipes sunk into the ground before starting the excavation. To decide the question a test pit was excavated to the required depth.

The making of the test pit was a rather difficult job. There were at first many slides, but they were eventually prevented by first making the slopes rather flat—1 to 5—and then draining them. When the slopes are quite dry it is possible to maintain a batter

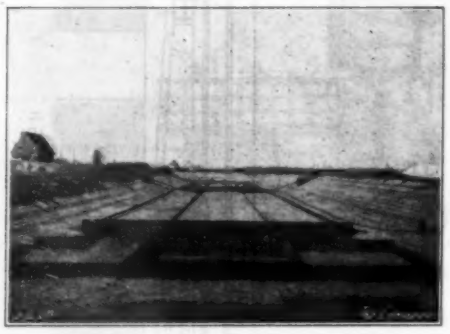


FIG. 14—EXCAVATION FOR FOUNDATION OF LOCK

of one vertical to two horizontal. The system of drainage adopted is shown in Fig. 9. The success achieved with the test pit resulted in the adoption of the same method for the excavation for the foundations. The trenches, the sides of which were lined with fascines, have not required any attention. The ground water level was thus kept down and the excavation for the foundations presented no difficulties, no slides occurring.

The excavating equipment consisted of the standard types of excavator, locomotives and dump cars, and the pumping equipment of four centrifugal pumps, each with a capacity of just over 2000 gallons per minute. The excavation for the foundation was

FIG. 15—MAKING AUXILIARY CULVERTS

commenced in July, 1920, and finished in January, 1921. The excavation for the foundation is shown in Fig. 14.

(5) Belting Course of Lock Walls and Culverts.

Unprotected concrete lock walls are unusual in Holland. As a rule the walls of such structures are protected by means of a belting course of basalt or hard burned bricks. Such protection is, however, rather expensive, and experience has demonstrated that it is difficult to get a satisfactory connection between basalt or brick and concrete. It is generally known that concrete with a high percentage of cement shrinks, so that cracks are formed. Concrete with a low percentage of cement is not strong enough to withstand abrasion by ships and will be worn away when, as in the culverts, water flows past it at high velocity. To overcome these disadvantages it was decided to face the mass concrete with walls composed of specially prepared concrete blocks 4in. thick and of the form shown in Fig. 10. In this way the lock walls are protected by a covering of very hard material, as the blocks during manufacture were subjected to a pressure of about 100 tons, and were made of concrete mixed in the proportion of one part cement to three parts of sand and fine gravel (to ¾in.), and were not placed in position till they had finished shrinking. The mortar between the blocks was mixed in the same proportions as the concrete of the blocks, and the width of the joints is ¼in. As the protecting wall, by reason of the shape of the blocks and the way in which they are arranged, bonds with numerous teeth into the concrete, the connection between it and the latter is excellent. The protecting wall and the concrete filling behind it are built up at the same rate. The front of the lock walls and the sides of the culverts are provided with protecting walls as described above. Experience has proved that the concrete blocks, when set in mortar, lie so firmly that concrete may be tamped behind the stones without moving the latter.

The author considers that this method of building concrete walls, which is new, as far as he knows, has the following great advantages:—

(1) A very hard concrete covering, that does not shrink and is very cheap, is provided.

(2) The wall has a much more satisfactory appearance than when the concrete is unprotected.

(3) Where the blocks are used expensive shuttering can be dispensed with.

The blocks were made on the site in an electrically driven press, the output of which was about 125 blocks per hour. They were built into the lock walls from a scaffold erected on two lorries running on the same track on the floor of the lock just alongside the walls. The platform for supporting the workmen and that for carrying the blocks and mortar can be fixed at different levels—see Figs. 11 and 12.

The roofs of the culverts are formed of semi-circular concrete arches of the same composition as the blocks and reinforced with B.R.C. fabric. These arches were built in sections 3ft. 4in. in length and placed by means of the cableways—see Fig. 13. The use of expensive shuttering for the culverts was avoided, since the concrete was placed above these arches. As with the roofs of the main culverts, the twenty-six auxiliary culverts were formed beforehand—see Fig. 15—and were placed in position by the aid of the cableways.

The Organisation of Research.*

It would be idle to recall the lowly position of chemistry as an educative force in this country, or to reconstruct the difficulties with which the scientific chemist was confronted during the first thirty years of the nineteenth century. Present difficulties are serious enough, and press for all our attention, without dwelling unduly on troubles of the past. But we must at least remember that in the early days of the British Association "schools" of chemistry were in their infancy, and that systematic instruction in the science was difficult to obtain. Another point of fundamental importance which has to be borne in mind is that the masters of the subject were then for the most part solitary workers.

It is difficult for us, looking back through the years, to realise what it must have meant to search for truth under conditions which were discouraging, if not actually hostile. Yet, although his labours were often thankless and unrewarded, the chemist of the time was probably a riper philosopher and a finer enthusiast than his successor of to-day. He pursued his inquiries amidst fewer distractions, and in many ways his lot must have been happy, save when tormented by the thought that a subject so potent as chemistry in developing the intellectual and material welfare of the community should remain neglected to an extent which to us seems incredible.

Public sympathy was lacking, Government support was negligible or grudgingly bestowed, and there was little or no co-operation between scientific chemistry and industry. As an unaided enthusiast the chemist was left to pursue his way without the stimulus, now happily ours, which comes from the feeling that work is supported by educated and enlightened appreciation.

Let me quote from one of Faraday's letters now in my possession and, so far as I can trace, unpublished. Writing to a friend immediately before the foundation of the British Association, he relates that a manufacturer has adopted a process developed in the course of an investigation carried out in the Royal Institution. The letter continues: "He" (the manufacturer) "writes me word that, having repeated our experiments, he finds the product very good, and as our information was given openly to the world he, as a matter of compliment, has presented me with some pairs of razors to give away." If ever there was a compliment which could be described as empty, surely this was one; yet the letter gives the impression that Faraday himself was quite content with his reward.

* * * *

The principles of science are to-day widely spread; systematic scientific training has found an honourable place in the schools and in the colleges; above all, there is the realisation that much of human progress is based on scientific inquiry, and at last this is fostered, and, in part, financed as a definite unit of national educational policy. Public funds are devoted to provide facilities for those who are competent to pursue scientific investigations, and in this way the State, acting through the Department of Scientific and Industrial Research, has assumed the double responsibility of providing for the advancement of knowledge and for the application of scientific methods to industry. Scientists have been given the opportunities they desired, and it remains for us to justify all that has been done. We have this morning glanced briefly at the painful toil and long years of preparation; now it falls to us to sow the first crop and reap the first harvest.

Thanks to the wisdom and foresight of others, it has been possible to frame the Government policy in the light of the experience gained with pre-existing research organisations. The pioneer scheme of the kind is that administered by the Commissioners of the 1851 Exhibition, who since 1890 have awarded research scholarships to selected graduates. When in 1901 Mr. Carnegie's benefaction was applied to the Scottish Universities, the trustees wisely determined to devote part of the revenues to the provision of research awards which take the form of scholarships, fellowships, and research lectureships. These have proved an immense boon to Scottish graduates, and the success of the venture is sufficiently testified by the fact that the Government research scheme was largely modelled on that of the Carnegie trust.

Two main objectives lie before us; the expansion of useful learning and the diffusion of research experience among a selected class. This class in itself will form a new unit in the scientific community, and from it will emerge the "exceptional man" to whom, quoting Sir James Dewar, "we owe our reputation and no small part of our prosperity." When these words were uttered in 1902 it was a true saying that "for such men we have to wait upon the will of Heaven." It is still true, but there is no longer the same risk that the exceptional man will fall by the way through lack of means. Many types of the exceptional man will be forthcoming, and you must not imagine that I am regarding him merely as one who will occupy a University Chair. He will be found more frequently in industry, where his function will be to hand on the ideas inspired by his genius to the ordinary investigator. I have no doubt as to the prosperity of scientific industries in this country so long as we avoid hasty and premature specialisation in those who control them. We may take it that in the future the great majority of expert chemists will pass through a stage in which they make their first acquaintance with the methods of research under supervision and guidance. The movement is already in progress. The Government grants are awarded generously and widely. The conditions attached are moderate and reasonable, and there is a rush to chemical research in our colleges. Here, then, I issue my first note of warning, and it is to the professors. It is an easy matter to nominate a research student; a research laboratory comfortably filled with workers is an inspiring sight, but there are few more harassing duties than those which involve the direction of young research chemists. No matter how great their enthusiasm and abilities, these pupils have to be trained, guided, inspired, and this help can come only from the man of mature years and experience. I am well aware that scorn has been poured on the idea that research requires training. No doubt the word is an expression of intellectual freedom, but I have seen too many good investigators spoiled and discouraged through lack of this help to hold any other opinion than that training is necessary. I remember, too, years when I wandered more or less aimlessly down the by-paths of pointless inquiries, and I then learned to realise the necessity of economising the time and effort of others.

Research supervision, if conscientiously given, involves the complete absorption of the director's energy and leisure. There is a rich reward in seeing pupils develop as independent thinkers and workers, but the supervisor has to pay the price of seeing his own research output fade away. He will have more conjoint papers, but fewer individual publications, and limitations will be placed on the nature of his work by the restricted technique of his pupils.

* * * *

One of the greatest anxieties of the research supervisor is, the avoidance of extravagance and waste. The student is sometimes inclined to assume a lordly attitude and to regard such matters as the systematic recovery of solvents as beneath his notice. My view is that, as a matter of discipline as much as in the interests of economy, extravagant working should not be tolerated. There is naturally an economic limit where the time spent in such economies exceeds in value the materials saved, and a correct balance must be adjusted, It is often instructive to lay before a research worker an estimate of the cost of an investigation in which these factors of time and material are taken into account. As a general rule it will be found that the saving of material is of greater moment than the loss of time. The point may not be vitally important in the academic laboratory, but in the factory, to which most of these workers eventually migrate, they will soon have the lesson thrust upon them that their time and salary bear a small proportion to costs of production.

Looking at the position broadly, if one may criticise the research schemes of to-day, it is in the sense that the main bulk of support is afforded

* Excerpts from the presidential address by Principal J. C. Irvine, C.B.E., D.Sc., LL.D., F.R.S., British Association, Section B, Chemistry.

to the research apprentice, and the situation has become infinitely harder for the supervisor in that new and onerous tasks are imposed upon him. To expect him to undertake his normal duties and, as a voluntary act, the additional burden of research training is to force him into the devastation of late hours and overwork. The question is at once raised—Are we using our mature research material to the best advantage, and is our policy sufficiently focussed on the requirements of the experienced investigator? I think it will generally be agreed that members of the professor or lecturer class who join in the movement must be relieved in great measure of teaching and administrative work. I am decidedly of the opinion that the research supervisor must be a teacher and must mingle freely with undergraduates, so as to recognise at the earliest possible stage the potential investigators of the future and guide their studies. To meet this necessity universities and colleges must realise that their curriculum has been extended and that staffs must be enlarged accordingly. There could then be definite periods of freedom from official duties for those who undertake research training as an added task. Opportunities must also be given to these "exceptional men" to travel occasionally to other centres and refresh themselves in the company of kindred workers. It is evident that our universities are called upon to share the financial burden involved in a national research scheme to a much greater extent than possibly they know.

I may perhaps summarise some of the conclusions I have reached in thinking over these questions. The first and most important is that in each institution there should be a board or standing Committee entrusted with the supervision of research. The functions of such a body would be widely varied and would include:—

(1) The allocation of money voted specifically from university or college funds for research expenses.

(2) The power to recommend additions to the teaching staff in departments actively engaged in research.

(3) The recommendation of promotions on the basis of research achievement.

(4) The supervision of regulations governing higher degrees.

Among the more specific problems which confront this board are the following:—

(1) The creation of research libraries where reference works can be consulted immediately.

(2) The provision of publication grants, so that where no periodical literature is available the work will not remain buried or obscure.

(3) The allocation of travelling grants to enable workers to visit libraries, to inspect manufacturing processes, and to attend meetings of the scientific societies.

I have dealt merely with the fringe of the question, but would add that there is one thing which a research board should avoid.

It is, I am convinced, a mistake for a governing body to call for an annual list of publications from research laboratories. Nothing could be more injurious to the true atmosphere of research than the feeling of pressure that papers must be published or the department will be discredited.

What I have said so far may seem largely a recital of new difficulties, but they are not insurmountable, and to overcome them adds a zest to life. It would have taken too long to go more fully into details and I have tried to avoid making my address a research syllabus, merely giving in general terms the impressions gained during the twenty years in which the St. Andrews research laboratories have been in existence.

A MOTOR SHIP FOR LOCOMOTIVE TRANSPORT.

AN interesting example of the conversion of an obsolete naval vessel into a mercantile ship for special uses is the newly completed locomotive transport ship Ægir. This ship, which, according to the V.D.I., recently left the Rüstringen yard of the Deutschen Werken A.G., is the second vessel which has been converted in this manner, the sister ship of the present vessel, the Odin, having been altered in a similar way some months ago. These ships, originally battleships of the "Siegfried" class, were built in the period 1893–1896, and were, before the war, engaged on coastal defence work in the Baltic Sea. The two triple-expansion steam engines have been removed and replaced by two four-stroke cycle six-cylinder high-speed Diesel engines. These engines, which were intended for use in a submarine, are each designed to develop 350 horse-power at a speed of 360 revolutions per minute. The structure of the ship has been modified in such a way that, in addition to various holds, a long flat deck is available for the carrying of cargo. In this particular ship the deck is furnished with a series of rail tracks placed crosswise on the deck, which provide accommodation for twelve locomotives and one tender, while nine additional tenders may be carried in the centre hold and two in the forward hold. The deck tracks are so laid that they are easily adjusted to suit the gauges of German, Russian and Spanish railways, and the arrangements are such that the preparations for transport which are usually necessary for locomotives are largely simplified and reduced. In consequence of the large holds and free deck accommodation and the high degree of stability of the vessel it is also specially adapted for the transport of wood and other bulky cargoes.

Iron and Steel Institute.

No. I.

A PLEASANT and, as it has turned out, a successful autumn Conference of the Iron and Steel Institute opened in the hall of the Yorkshire Philosophical Society at York on Tuesday, under the presidency of Mr. Francis Samuelson. The attendance was not large, but it was representative, and the opening day's discussions reached a higher level of practical interest than is perhaps usual on these occasions.

In the unavoidable absence of the Lord Mayor of York, the deputy Lord Mayor, Mr. Alderman E. Walker, offered the Institute a cordial welcome to the ancient city.

Mr. R. L. Wedgwood (general manager of the North-Eastern Railway) also addressed the meeting as a representative of the city. Those engaged in the iron and steel trades did not, he said, need a formal welcome to the capital of Yorkshire or to the North-Eastern Railway. The President of the Institute was a Yorkshireman, and a study of the list of past-Presidents and the present officers of the Institute would reveal the names of well-known natives of the county. If the ironmasters and steel makers of Sheffield, Middlesbrough and Leeds could not feel at home in Yorkshire, who, he would ask, could? With regard to the North-Eastern Railway, there was the closest connection between it and the iron and steel industry. The railway had fetched and carried for the iron and steel and coal trades throughout its existence, and its prosperity depended on the prosperity of these great industries.

The first business was concerned with the alteration of the by-law regulating the tenure of office by the President. Under the existing by-law the President holds office for two years, and notice was given of a change whereby future Presidents will only be elected for one year. A resolution to this effect will come before the next annual meeting in London, in May, 1923.

The first paper on the agenda was that by Mr. A. K. Reese, "The Basis of Modern Blast-furnace Practice." We hope to reprint this paper in a future issue.

Professor Henry Louis, who opened the discussion, expressed his full agreement with the author on many points, but said he was in conflict with him on one or two of the matters discussed. He could not accept the statement that the use of dry blast was due to Mr. James Gayley, or that the credit in this connection belonged to America. He recalled the work of Mr. Charles Cochrane in this field thirty or forty years ago, and a paper which was presented to the Institute in which the theory of dry blast was set out. It was hoped at that time that certain advantages would follow the use of dry blast, but the conclusion was reached that the system was not economically sound. He was inclined to think that some had the same idea with regard to the present methods of using dry blast, but the main point he wished to make was that the credit of introducing the system belonged to Great Britain and not to the United States. The other special point he wished to raise was one of opinion rather than fact. Mr. Reese had stated his main object as the attainment of the greatest possible output consistent with quality. He doubted if that view was sound. What ought to be the aim of the ironmaster was the greatest possible economy consistent with quality. Economy and quantity were not necessarily associated. He believed that if an output of 1800 tons a day was required it would be a preferable plan to produce that quantity in six furnaces each of 300 tons capacity rather than three of 600 tons capacity, from the point of view of economy in fuel consumption, which, in his opinion, should be the real goal.

Mr. Guy Barrett dealt with the question of small sizes of coke. Experience had shown, he said, that small coke was not always an advantage, as it contained a large proportion of moisture and ash. There was a good case for buying coke on its analysis. With regard to the grading of the ores there were strong arguments in favour of reducing ores to a smaller and more regular size, and he was more in favour than Mr. Reese of having the limestone of a regular grade. He had had unfortunate experience of using very small limestone on occasions when stocks had fallen to a low level. He had an open mind on the subject of dry blast, but he had grounds for believing that the reason it had been given up in many instances was that it had not proved a financial success. Otherwise its value must be very great. The reference to "effective bosh area" was not new, as the question had been raised by Mr. Clements in a paper presented to the Institute in the year 1920. While he agreed with the author that a large hearth was justified in some cases, the very large hearth did not give the advantages claimed for it, and in some cases gave rise to serious trouble.

Mr. F. Clements confessed to a tinge of disappointment with the paper. The author laid down the principles of blast-furnace work, but he left them in doubt how far the bases indicated were supported by his own experience. He (Mr. Clements) assumed the conclusions stated were supported by definite evidence, but the evidence was withheld. Dealing with the various points raised, he was in agreement with Mr. Reese on the grading of the material put into the furnace from the theoretical standpoint; but when that subject was considered from the point of view of experience at Staveley and Park Gate, where 2000 tons of material a day were handled containing only about 28 per cent. of iron, it was a question whether it was worth while to do it. Gas cleaning was another point on which differences of opinion existed, and his own idea was that the right type of gas cleaner had yet to be evolved. With regard to the area of the bosh, he had pointed out that it was the effective area of the bosh which governed output.

Mr. E. C. Evans referred to an investigation of the structure of coke in which he was engaged. The author referred to what he considered the wasteful reactions upon the coke of the CO_2 in the gases. He joined issue with that statement, believing that these reactions were far from being detrimental. Fuel of high combustibility was soluble in carbon dioxide, and the use of fuel of that character should result in a considerable diminution of temperature, and the output of the furnace should be increased. He believed that the question of the structure of the coke was a matter of vital importance to the iron industry. Coke might have a large degree of porosity and yet possess a density equal to that of coal. With a charcoal fuel the consumption could be reduced to 10 cwt. per ton of pig iron, and there was certainly the possibility of producing pig iron regularly for a consumption of 10 cwt. to 12 cwt. of fuel per ton.

Mr. E. G. Duff gave a brief account of experience with lime kilns where, by using material of uniform size, improved results as compared with earlier practice had been secured. The speaker referred to the results of experiments designed to produce the highest possible percentage of CO_2 in regular quantities. By breaking the limestone down to 4in. squares a percentage of 38 was eventually reached, and at the same time consumption of material reduced by nearly two-thirds, *i.e.*, from 4 cwt. to 1¼ cwt.

Mr. D. E. Roberts agreed with Mr. Clements that the paper scarcely did Mr. Reese justice. The author had had a more comprehensive experience of blast-furnace operation than most people, and could have told a great deal more than he had elected to do. He regarded what was being done by Mr. Evans as of the first importance, and believed that the method he was advocating had great possibilities.

Mr. W. J. Foster also expressed disappointment that the paper did not contain more matter. The author told them many things they knew already as being necessary if good results were to be obtained. He believed that the chances of producing a ton of iron for an expenditure of 10 cwt. of charcoal fuel were very hopeful, and would remind them that Sir Lowthian Bell at one time worked on 12 cwt. per ton of iron. One reason for the better result with charcoal was that it absorbed a tremendous quantity of gas, and it had been shown as long since as 1902 that it was this characteristic which prevented the reaction of CO_2. He disagreed with the author on the question of coke density; the degree of density required had not yet been reached. A dense coke would traverse the furnace without excessive attack from CO_2. On the general question he agreed that if uniform conditions could be obtained in the blast-furnace it would be a great advantage, but the question of the cost of attaining such conditions had to be very carefully considered. If the thing could only be half done, then it was better to give attention to the limestone rather than to the ironstone, which was melted more easily than the other materials. The use of dry blast was unpopular because of the cost of upkeep.

Mr. J. H. Harrison dealt with the question of design. The author had not, he thought, laid sufficient stress on the distribution of the materials in the furnace. The best area for the bell was about half the area of the throat of the furnace. With a throat of 14ft. the bell should be 10ft., and with a throat of 15ft. the bell should be 10ft. 6in. The reason for selecting those dimensions was that as the material slid off the bell into the furnace it was dropping more or less perpendicularly. The bell angle of 40 deg. to 45 deg., and in some cases 50 deg., referred to in the paper, was too steep, and was apt to cause destruction of the brickwork; an angle of 38 deg. was to be preferred. Mr. Reese had also referred to gases ascending against the wall. He could not accept that statement. The centre part of the charge descended more rapidly than that at the sides. This was due to the effects of friction. There was more room for the gases to ascend near the centre than at the side walls. The top slip referred to was due to carbon deposition, and bottom slip the result of the falling away of the scaffolds, which were caused by the accumulation of fine material, mostly carbon, on the boshes and within the zone of fusion. The cylindrical throat should not be carried down to the point where carbon deposition began, which was usually about 6ft. below the stock-line, and continued for about 10ft. The stock should batter outwards at this point not less than 0.8in. per foot. With regard to high blast-furnace temperatures referred to of from 1450 deg. to 1550 deg., some Cleveland firms were regularly using temperatures twenty years ago of 1500 deg. to 1550 deg., and using less coke than anyone else on Cleveland iron. The special temperature trouble referred to by the author could be overcome by lowering the top of the bosh and by decreasing the angle to 68 deg. in place of 80 deg.

Mr. H. K. Scott wanted to know how to deal with

Northamptonshire ores which declined to be crushed. He hoped that the homily read to blast-furnace owners by Mr. Reese would not have been read in vain. A great responsibility rested on owners to put in proper equipment for the working of their furnaces, and particularly the handling of the materials.

Mr. C. H. Ridsdale agreed that Mr. Reese had given good advice, and it was necessary to keep on reiterating this advice until blast-furnace practice was placed on a scientific basis. The blast-furnace was a chemical proposition, and had to be considered from that point of view. In his own experience he had knowledge of two plants using almost similar materials, but as a result of breaking down the materials for one furnace the fuel consumption of the furnace fed with that fuel and with the poorer materials was reduced to 21 cwt. compared with 27 cwt. in the other case. That was twenty-two years ago. There was one characteristic of small material; it always contained a proportionately larger percentage of silica. He was much interested in the work which was being done by Mr. Evans.

Mr. Reese, in replying to the discussion, accepted the correction on the subject of the first use of dry blast, but expressed the opinion that Gayley was the man who brought it to the front. He hoped that Professor Louis did not agree that the greatest output consistent with quality was the end for which to strive, and he had criticised the large furnace. He could tell the meeting that the large-output furnace had a lower fuel consumption than was generally imagined. Figures had been published recently showing the consumption of fuel to be from 16 cwt. to 17 cwt. per ton with outputs of 800 tons. Nor were these high-capacity furnaces as large as many people appeared to think, 85ft. to 90ft. being the standard size. Large output, it should be remembered, had a beneficial effect on the economy of the whole plant. The general practice in breaking down materials was to obtain a 3in. size, and with dense ore a 2in. standard was observed, but good results could be obtained with ¼in. ore. Mr. Clements had referred to the cost of crushing the ore, but the advantages of crushing the ore could not be obtained unless other features were incorporated in the working. With regard to the lack of details of his experience to which reference had been made by several speakers, the paper was not intended to be a treatise on blast-furnace operation, but on the bases of the work. The facts mentioned in the paper reflected thirty-five years' experience of blast-furnace work, the faculty of observation, and a certain amount of common sense. He had no statistics with which to satisfy Mr. Clements. Mr. Evans had raised a question which indicated the possibility of a radical change in the economic production of pig iron. His scheme and work were beyond the scope of that day's discussion. The proper thing for Mr. Evans to do was to produce a sufficient quantity of his "charcoke" to enable a sound test to be made in a blast-furnace of the most modern type. Results would then be obtained which would either prove or disprove his contentions. He would refer to some of the other points raised in a written contribution.

A cordial vote of thanks was accorded to the author for his paper.

An investigation on "The Factors Influencing the Grain and Bond in Moulding Sands" was the subject of a contribution by Mr. C. W. H. Holmes.

This investigation was undertaken with a view to estimating quantitatively the effect upon the essential properties of the sand of the various processes to which moulding sands are subjected. The essential properties that fall within the scope of this research are:—(a) The strength of the bond; and (b) the ratio of the various mechanical grades, which is the determinant of the venting properties of the sand. The author reaches the following conclusions:—

(1) That the mechanical and physical properties of sands for grey-iron founding are of equal importance to the chemical analysis.

(2) That the bond absorption value obtained on the raw sand may be greatly modified by mechanical treatment.

(3) That the most successful moulding sands contain both static and mobile bond.

(4) That an appreciable degradation of the grains of a moulding sand occurs during the mechanical preparation as usually effected.

(5) That the bond distribution factor is a characteristic of moulding sands that is of great importance in view of the excessive degradation, which may be caused by prolonging milling beyond the time needed to effect the optimum distribution.

(6) That no single test is sufficient on which to judge the practical value of many moulding sands, a careful consideration of all the tests described in the paper being required.

Mr. J. E. Fletcher (Cast Iron Research Association) expressed his satisfaction with the work described in the paper. Far too little had yet been done in Great Britain to investigate the question of the sands used in moulding, and foundrymen were anxious to obtain scientific information. The author had very properly emphasised the great importance of studying the physical characteristics of moulding sands apart from chemical composition, and he had brought out quite clearly the colloidal effect which occurred. It had also been shown that sands could be milled efficiently in a very short time, and attention had been directed to the need of great care in mixing sands if the desired results were to be obtained. It often happened that the use of water was responsible for the troubles experienced by moulders. The British Cast Iron Association was trying to collate sands and standardise methods of testing, but this was only the beginning of the work.

Dr. W. H. Hatfield agreed as to the value of the work, but suggested it was even more important to both the iron and steel branches of the industry that a simple and effective method should be devised of determining the suitability of any sand for a particular purpose. He recalled a case at a foundry in the Pas de Calais where a green sand was dug up out of an adjoining field, milled inefficiently, and used for steel making with excellent results.

Other speakers, who included Mr. E. Adamson, Mr. J. Lester, and Mr. H. K. Scott, expressed the hope that the study of the subject would be continued until standardisation was attained. Until now the only test for making castings was, it was pointed out, the casting itself. If a sand gave good results its use was continued without any knowledge of what properties in the sand enabled the desired results to be obtained. Stress was laid on the necessity of the author working in conjunction with others who were engaged in research work on the same subject in the United States, so that the results attained would be comparable. Another point raised was that in cast iron work the sand was used in a mixture with manure, and that this fact might prevent the work which was in progress being useful in the foundry.

Mr. Holmes, in a brief reply, said that a revolution in practice was in prospect. Mr. Fletcher had found the bond absorption test to be of limited value. It was quite useful for some purposes, but could not be satisfactorily employed in comparing widely divergent sands. With regard to the cantilever test, it was not smooth enough for weak moulding sands. He had adopted the same method for standard bar tests as was used by the leading workers in America. With regard to sands mixed with manure and other ingredients, he had found that the addition of coal dust reduced the bond, but the question opened up a big field of work.

The author was warmly congratulated on his contribution.

A paper, "On the Diminution of Lag at Ar1 through Diminution," was presented by Mr. J. H. Whiteley.

Evidence of lag in the crystallisation of pearlite, particularly in hypoeutectoid steels, is derived from several considerations. It is found in the well-known fact that for a given steel the temperature of the Ar1 transformation is not constant, but is lowered as the rate of cooling is increased. Again, since the presence of carbide nuclei within the γ-iron areas induces crystallisation of the carbide and ferrite as globular pearlite at a temperature considerably higher than that at which growth takes place in the absence of such nuclei, lag must clearly occur in the latter case. Further, the growth of lamellar pearlite, when once started, does not occur simultaneously throughout the specimen. The change proceeds gradually, and there is no difficulty in quenching a piece so that it contains areas of both pearlite and martensite intermixed. These facts make it clear that lag occurs at Ar1, which means that ordinary lamellar pearlite is formed from a supersaturated solid solution. In the case of supersaturated liquid solutions, it has been found that agitation or stirring of the liquid is sometimes effective in initiating crystallisation and thus reducing lag.* Usually, in determining the recalescence points, the specimen is allowed to cool undisturbed, and it therefore appeared of interest, at any rate from a theoretical standpoint, to ascertain whether the temperature and rate of pearlitic growth could be increased through disturbances of structure caused by deformation of the steel when in the metastable condition of supersaturation. Results obtained from repeated experiments all agreed. They showed unmistakably that lag at Ar1 could be diminished by slight deformation.

Dr. W. H. Hatfield said the paper did not lend itself to discussion. Lag was diminished by this mechanical disturbance. It was reasonable to suppose that this would happen and that the eutectoid would split up into its several constituents at a higher temperature. The author's work had added considerably to the knowledge of pearlite in its different aspects.

The last paper taken on the first day of the meeting was that by Mr. L. E. Benson, "The Nitrogenisation of Iron and Steel by Sodium Nitrate."

During some experimental work, specimens of armco iron and steels of varying composition were annealed in a salt bath at a temperature of 500 deg. Cent. for varying lengths of time. Subsequent microscopical examination showed that most of the specimens so treated had developed a structure within the ferrite grains similar to that generally associated with the presence of nitrogen. The structure appeared to consist of a dark etching—picric acid or 1 per cent. alcoholic nitric acid—constituent, occurring as plates or lines usually along the cleavage planes of the ferrite grains, and occasionally along the grain boundaries. Careful examination of the original materials showed that in all cases the structure was perfectly normal. The specimens were all normalised from 950 deg. Cent. before annealing. The annealing was effected by immersing the specimens in a salt bath composed of sodium nitrate, 85 per cent., and potassium chloride, 15 per cent., contained in a cast iron crucible. Although the specimens whilst in the salt bath stood on a porcelain plate, carburisation of the specimens by diffusion of carbon from the cast iron container, or from carbonaceous impurity in the salt, appeared to afford a possible explanation of the structure. In order to explore this possibility, a specimen of the normalised armco iron was annealed for 2½ hours at the same temperature in a bath of recrystallised sodium nitrate contained in a porcelain crucible. As a result of this treatment, the iron was found to have developed the nitride structure to an average depth of 0.2 mm. from the surface. To obtain positive evidence of nitrogenisation, both unannealed and annealed specimens of armco iron were analysed for nitrogen. A sample of armco iron before annealing was found to contain less than 0.002 per cent. nitrogen. A specimen annealed for 10 hours was observed under the microscope to exhibit the nitride structure to an average depth of 0.4 mm. Approximately 1.5 mm. was filed off all the faces of this specimen and the filings collected. A further 1 mm. was then filed off. The nitrogen content of the three samples was found to be as follows:

	Per cent. nitrogen.
Outer layer	0.036
Intermediate layer	0.004
Core	0.002

From these determinations, it would appear that the specimens in question had become nitrogenised through being annealed at a temperature of 500 deg. Cent. in a salt bath containing sodium nitrate. The fact having been ascertained, the rate of penetration of nitrogen in iron and some steels was determined, and in the case of armco iron was found to settle down to a rate of about 0.02 mm. per hour.

Mr. Whiteley said that the paper recalled a contribution to the same subject by Mr. Jones, of Woolwich Arsenal. It was then shown that solution of nitrates dissolved the grain boundaries more than the internal parts of the crystal and caused brittleness in the steel. The author in this case had not brought forward evidence that the nitrides were really nitrides and not nitrates. It was difficult to believe that nitrides would form in steel at the temperatures named.

Mr. Benson admitted the lack of positive evidence that nitrides were present, and could not give any equation for the formation of nitrides, as he did not see how the action could come about. He deemed the phenomena recorded sufficiently interesting to be brought to the notice of members of the Institute.

The meeting then adjourned until the following day.

At the conclusion of the formal meeting a demonstration was given at the Festival Concert Rooms of the new McConway process for the production of steel discs by centrifugal hydraulic methods direct from molten steel. The process was shown by cinematography, and was followed with much interest. The operations involved in the centrifugal hydraulic process are as follows:—In the first instance a simple cylinder of any desired weight is produced. As an example, the production of a cylinder 30in. diameter and 12in. long, weighing from 10 cwt. to 12 cwt., may be taken. The molten steel is poured into a matrix revolving at a peripheral speed of 65ft. per second. The initial length of the cylinder is 12in., the inner end butting against a piston 30in. in diameter, which operates under hydraulic pressure to shorten the cylinder as it cools to its solidification point. When this has been reached, further pressure is applied to expel the resultant disc from the matrix.

* Recently, A. F. Hallimond, in discussing this question of delayed crystallisation, has remarked that for supersaturated solid solutions violent mechanical working may be the analogue of agitation—*Journal* of the Iron and Steel Institute, 1922, No. I., page 359.

CULTIVATION OF COTTON IN AUSTRALASIA.

THE Government of Queensland is taking steps to secure the services of a cotton culture expert from abroad, and communications on the subject from the United States and Great Britain are receiving consideration. It is announced by Mr. Crawford Vaughan, chairman of the Australian Cotton Growing Association, that this body is now in the position to deal with the entire cotton crop of Australia and all its by-products. It is the intention of the Association to erect spinning mills in the near future. Mr. Vaughan declares that the increase in the acreage under cotton this year has been abnormal. Applications for seed to plant 55,000 acres have been received, and it is anticipated that sufficient seed will be distributed to sow 75,000 acres. The acreage under cotton for the 1922 planting is likely to reach between 30,000 and 40,000. Mr. Vaughan attaches great significance to the announcement that the Federal Government has invited a delegation of Lancashire cotton spinners to visit the Commonwealth. At the commencement of the season, a crop of 4,000,000 lb. of seed cotton was expected, but it is now rather doubtful whether this figure will be reached. At present 3,100,000 lb. have been received. The season's crop was roughly 6000 acres, and to the end of June 1986 bales of lint had been shipped from Queensland. The Rockhampton ginnery has ceased work for the season after an uninterrupted run of three months. The Cotton Growing Association has promised to erect a ginnery at Lismore, in Northern New South Wales, provided 2000 acres are planted in the coming season. The Primary Producers' Union has given an assurance that this area will be planted. The Dominion Government has been asked to undertake experiments with a view to ascertaining the possibility of cotton growing in New Zealand.

A YEAR ago, on the termination of control, the Irish railway companies proposed to reduce their men's wages. This proposal was resisted, but eventually an agreement was arrived at, which has since been extended and was finally to expire on August 15th, the anniversary of decontrol. The railway companies have now intimated to the Provisional Government that in view of the present disturbed state of the country, and in the national interest, they will carry on to the best of their ability until the end of the year under the present conditions, it being understood that the Government will see that the interests of the shareholders are not prejudiced.

THE retirement on the 30th instant of Mr. Bowman Malcolm, the engineer and locomotive superintendent of the Northern Counties section of the Midland Railway, reminds us that he started with the Belfast and Northern Counties Railway in 1870, and six years later, when, we believe, only twenty-two years of age, was made the locomotive engineer. In 1906, when the late Mr. Berkeley D. Wise retired from the position of chief engineer, the duties were transferred to Mr. Malcolm. One of the works now being completed under him, as engineer, is the construction of a new bridge, 800ft. long, over the river Bann at Coleraine, and a deviation of the railway, which were sanctioned by the Midland Railway Act of 1914, but owing to the war were not begun until last year. Mr. Malcolm had wished to retire some time ago, but retained office at the wish of the Northern Counties Committee.

A Seven-Day Journal.

The Circuit of Britain Air Race.

THE competition for the cup presented by his Majesty the King for an aerial race round Great Britain starts to-day (Friday), the first machine leaving Waddon Aerodrome, Croydon, at 9 a.m., with the others following at intervals equal to their handicap times. The total course covers 810 miles, and is divided into two sections, namely, Croydon to Glasgow *viâ* Birmingham and Newcastle, and Glasgow to Croydon *viâ* Manchester and Bristol. Twenty-three machines have been entered for the contest. They are of a notably diverse assortment in the matter of design, and are none of them essentially racing machines. They range in size from the small 35 horse-power Avro Baby to the large ten-seater 400 horse-power Bristol biplane. Some of the machines are well-known war-time designs, such as the de Havillands 4 and 9 and the S.E.5a. Others belong to the immediate post-war period such as the Sopwith Gnu. With the exception of the Supermarine flying boat Sea Lion II., the winner of the recent contest at Naples, the most modern is the Vickers Vulcan. The competition is under the control of the Royal Aero Club, and is expected to finish to-morrow (Saturday).

Birmingham and Canal Improvements.

BIRMINGHAM'S increasing interest in the improvement of inland water transport has once again been shown by the resolution passed by that city's Trades Council at its meeting last Saturday, whereby it pledged itself to support a proposal to widen and deepen the canal between Birmingham and Worcester so as to permit the passage of 250-ton barges. The length of canal requiring development under the scheme is only 26 miles, yet were the proposal carried out it would, it is believed, have a very pronounced effect on Birmingham's industrial position. It would for one thing probably tend to alter the views of those manufacturers who are gradually becoming convinced that a move to the coast or nearer the coast is the only way to save their business. The scheme contemplated would result, incidentally, in the number of locks on the canal in question being reduced from sixty-two to ten, and in this respect alone would prove of great assistance to transport.

The Loss of the Liner Egypt.

THE report and findings of the Court of Inquiry appointed to investigate the circumstances in which the P. and O. liner Egypt was lost off Ushant on May 20th contain remarkably little of technical moment. The vessel was struck by the French steamer Seine during a fog, and sank in twenty minutes with the loss of 16 out of 44 passengers and 71 out of 294 members of the crew. The total number of persons which the Egypt's certificate authorised her to carry was 807. Her eighteen lifeboats were capable of accommodating 860 people. Yet of the 338 on board at the time of the disaster, one in every four lost their lives. The Court of Inquiry found that the collision was not due in any way to the manner in which the Egypt was being navigated. After the collision, however, proper measures were not taken to close the water-tight bulkhead doors, for maintaining discipline or for promptly swinging out and lowering the boats. The master, the chief officer and the owners are held jointly responsible for the failure of discipline and the consequential loss of life. There is here, then, no question of defective or insufficient life-saving or other equipment such as has aroused attention in connection with many other marine disasters. The loss of life which followed the collision was attributable largely or solely to the failure of those in charge to make proper use of the equipment provided.

An Atlantic "Hostel" at Southampton.

A LARGE scheme for providing hotel and similar accommodation in the neighbourhood of Southampton for, presumably, the convenience of Atlantic travellers, is foreshadowed by the registration of the Atlantic Park Hotel Company, Limited. The scheme is being promoted jointly by the Canadian-Pacific Railway Company, the Cunard Steamship Company, and the Oceanic Steam Navigation Company. Land and buildings are to be acquired at Eastleigh for the purpose of the scheme—the land and property in question having lately formed part of the Eastleigh Aircraft Acceptance Park. The nominal capital of the company is £99,999 in £1 shares, and among the items specified as those which will form its business are the running of hotels, restaurants, &c., acting as passenger and forwarding agents, warehousemen, motor car proprietors, bankers, proprietors of baths, dressing rooms and laundries, and so on.

Continental Air Traffic.

WHILE in several respects the latest available returns for the traffic on the continental air services from and to Croydon show a marked improvement over previous figures, it is still quite evident that aerial transport has not yet reached a sound commercial basis. For the month of July, according to the Air Ministry statistics, there were 711 arrivals and departures of machines, an increase of nearly 100 over the previous best monthly figure. Between them the machines of the three British companies accounted for 446 arrivals and departures, or about 63 per cent. of the total. The number of passengers carried was 1592 all told, or a little over two per flight on the average. Of this total, 1272, or about 80 per cent., were carried by the British companies' machines. The greater proportion of the freight transported, totalling 73.3 tons for the month, was also carried in British machines. This figure for the total weight of goods borne by air is the largest recorded for any monthly period. The increase was principally due to the growth in the newspaper traffic, of which 34.4 tons were handled. The efficiency of the British services reached nearly 96 per cent. In spite of the favourable nature of these statistics, the fact, however, remains that the passenger accommodation actually utilised on the British aircraft engaged on the services was only 36 per cent. of that available, and the cargo capacity only 47 per cent.

New Grain Elevator at Glasgow.

UP till quite recently Glasgow's quays were equipped for grain handling solely with elevators of the old-fashioned bucket type. Even the fine modern granary at Meadowside, opened a few weeks before the outbreak of the war, was served by bucket elevators. Now, however, an up-to-date pneumatic suction elevator has been installed at Meadowside, and was brought officially into use on Tuesday. It has a capacity of 100 tons of grain per hour, as compared with 250 tons per hour for each of the two existing bucket elevators with which it is specially arranged to work in conjunction. The elevator has been supplied by Messrs. Simon, of Manchester.

The Cumberland Mine Disaster.

A SERIOUS colliery explosion, which we regret to say has resulted in a heavy death-roll, took place on Tuesday morning at the Whitehaven Colliery Company's new Haigh Pit, Whitehaven. The explosion, which occurred during the first shift, took place in the workings known as the Six Quarters seam, which are situated about 1400 yards from the pit shaft and run under the sea. The severity of the explosion caused heavy falls of roof, and the work of rescue was greatly impeded by these falls and the fumes and gas resulting from the explosion. The Haigh Pit adjoins the Wellington Pit, which was the scene of the disaster of 1910, when 136 lives were lost, and only a fortnight ago communication was established between the two pits. At first it was thought possible that some of the thirty-nine men entombed might have escaped through this passage into the workings of the Wellington Pit, but examination revealed the fact that heavy falls of roof had taken place on both sides of the scene of the explosion, and that this means of escape had been apparently cut off. All hope of rescuing the men remaining in the mine has been abandoned.

Motor Cycle Noise.

THE announcement that the British Motor Cycle Racing Club will not hold the 500-mile motor cycle race on the Brooklands track at Weybridge on the 28th instant, owing, it has been stated, to the annoyance that would be caused to local residents by the noise of the exhaust from the competing machines, again raises the question of the possibility of the effective silencing of vehicles under test and also on the open road. With regard to Brooklands, we understand that the question of noise has handicapped the continuous testing of vehicles from the very first, and that after the first twenty-four hours' trial was run early in the first season, it was arranged, in deference to local complaints, only to run twelve-hour trials on consecutive days. The problem of effective silencing is one which might well receive the attention of automobile and motor cycle engineers. Considerable work on the analysis and recording of sound has already been done by Dr. A. M. Low, who has made a machine for taking an automatic record of the sounds emitted by mechanically propelled vehicles.

The New Cunarder Ausonia.

THE new Cunard liner Ausonia, which sailed from Liverpool on her maiden voyage on the last day of August, is the eighth ship of the company's post-war building programme. She has been specially designed for the Canadian trade, and is a two-class liner having accommodation for 510 cabin and 1178 third-class passengers. The cabin accommodation includes, in addition to the dining saloon, a lounge, smoking room, veranda café, and a children's playroom. Particular attention has been paid to the requirements of third-class passengers, and the accommodation provided reaches a very high standard. Both two-berth and four-berth cabins are provided, and the groups of rooms are separated by spacious alleyways. The Ausonia was built on the Tyne by Sir W. G. Armstrong, Whitworth and Co., Limited. Her machinery is of the twin-screw double-reduction geared turbine type, while her boilers are equipped for oil burning. As in almost all the recent additions to the fleet of the Cunard Company, this vessel is a one-funnelled ship, an arrangement which allows of a more convenient distribution of passenger accommodation. The leading dimensions of the Ausonia are as follows:—Length, 538ft.; breadth, 65ft.; moulded depth, 43ft., with a gross tonnage of 15,000. She is designed for a speed of 15 knots.

The Late Mr. Charles Godfrey Phillips.

WE very much regret to have to record the death of Mr. Charles Godfrey Phillips, who was accidentally killed at Llandrindod Wells on Monday last through falling from the window of the hotel at which he was staying. Mr. Phillips, who was forty-eight years of age, was educated at Christ College, Brecon, and since the death of his father in October, 1912, he took part in the joint management of the engineering and foundry business of Charles D. Phillips, Emlyn Engineering Works and Foundry at Newport, Mon., which was founded by his father, the late Mr. Charles D. Phillips. In addition to his engineering activities, Mr. Phillips was a keen agriculturist, and well known in agricultural circles.

Interesting Steamer Conversions.

Two Canadian-built steamers—the Willdomino and the Sylvia Victoria—which are lying in the James Watt dock at Greenock, are about to undergo a somewhat unusual conversion. According to information received, the ships have recently changed hands, and the new owners have decided to take out the existing double-reduction geared turbines and to replace them with triple-expansion engines. John G. Kincaid and Co., Limited, of Greenock, have been entrusted with the work, and are to supply and fit to each ship a new set of triple-expansion machinery of 2700 indicated horse-power. The oil-burning steamer Courtois, which was built by the Great Lakes Engineering Works for the United States Emergency Shipping Board in 1918, has recently been purchased from the United States Shipping Board by the Munson Steamship Line, of New York, at the low price of about 10 dols. per ton. The company also purchased from the Board two 900 brake horse-power four-stroke cycle six-cylinder McIntosh and Seymour Diesel oil engines, for the purpose of converting the steamer into a motor ship, and we understand that the low purchase price was accepted by the Board on the understanding that the vessel should be converted. When equipped with Diesel machinery the vessel is expected to have a speed of 8 to 8½ knots. The ship will be employed on the New England coast coal-carrying trade, and her performance will be watched with interest, with a view to the similar conversion of other ships.

Fire Risks on Motor Boats.

THE Mercantile Marine Department of the Board of Trade has recently issued recommendations with regard to conditions existing on motor boats using petrol, with the object of urging the builders and owners of such vessels to take adequate precautions to prevent the risk of fires and explosions. Regulations have already been issued for motor boats which are intended to carry more than twelve passengers, and which are consequently periodically inspected by the surveyors of the Board, and the new recommendations are intended to cover motor boats not included under the above-mentioned regulations. Whenever practicable the following conditions should be complied with. The motor, if placed below deck, should be isolated by being enclosed in a separate well-ventilated and fireproof casing, with water-tight bulkheads to prevent any leakage of oil or petrol gaining access to other spaces. The petrol tank, which should be large enough to do away with the necessity of carrying a supply in spare tins, should preferably be placed on deck, and both the tank and the fittings should be oil and petrol-tight, the tank further being furnished with suitable filling appliances and gauze-protected outlets and inlets. No parts of petrol pipes or couplings should depend on soft solder for tightness, and all exhaust pipes should be efficiently cooled. Adequate means for fire extinguishing should be carried, including sand, and one or more chemical extinguishers, preferably of the type discharging foam. The Board calls attention to the fact that an increased number of motor vessels are now using paraffin, and only a small quantity of petrol is carried for starting purposes. An extension of this practice is, from the point of view of safety from fire risk, much to be recommended.

The Devonshire Ironworks.

THE Devonshire Works of the Staveley Coal and Iron Company, Limited, consist in the main of a thoroughly modern and up-to-date blast-furnace plant, one of the largest coke-oven plants in the kingdom and extensive pipe foundries for the manufacture of the cast iron pipes for which the company is so widely and favourably known. The works likewise comprise a large by-product recovery plant, and chemical plant for the manufacture of sulphuric and nitric acids, and other chemicals.

Although the company's works at Staveley are amongst the oldest in the country, having records dating back to 1702, the Devonshire works are comparatively new. The existing blast-furnaces are all of the most modern type, three of them having been built in 1906, while the fourth was built some years later. Of the three earlier furnaces, No. 3 has quite recently been entirely re-modelled, and is now the largest blast-furnace in the Midlands.

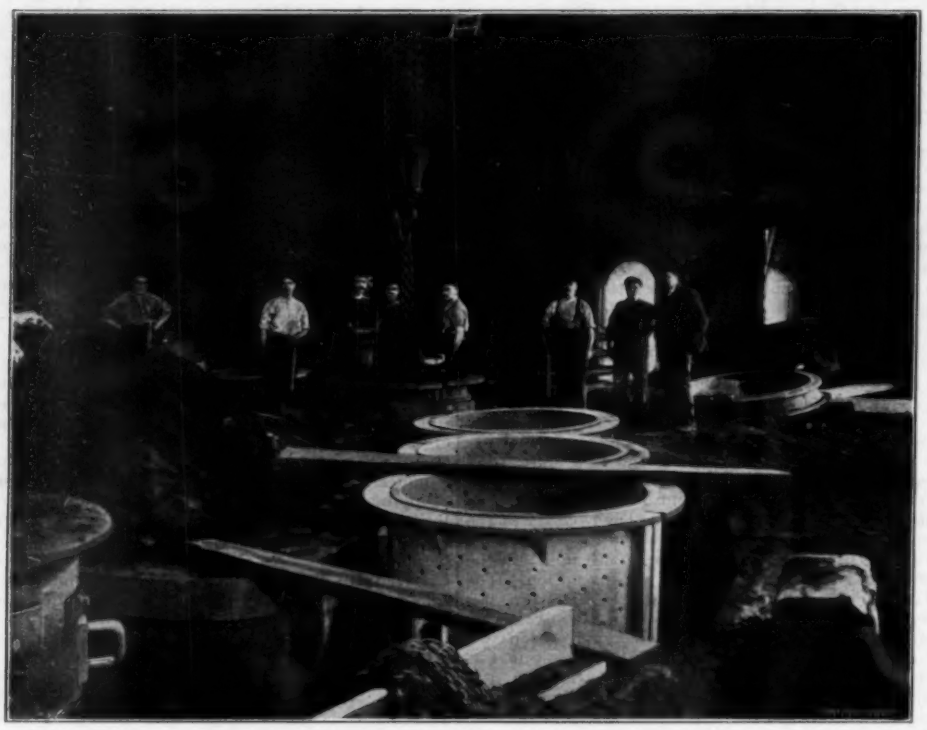
In laying down the blast-furnace plant the company was in the favoured position of having ample room for developments, and was therefore able to make the plant spacious and convenient. The furnaces —see page 246—are arranged in symmetrical pairs, the distance between centres being no less than 125ft. Each of the furnaces has its own battery of three Cowper stoves with extra high tops (75ft.) and an hopper type and practically identical with the top described in the article on the Park Gate furnace published in THE ENGINEER of June 6th, 1919.

Blast is supplied by five Galloway vertical blowing engines with 90in. blowing cylinders, each capable of delivering from 20,000 to 22,000 cubic feet of air per minute. The blast pressure varies from 8 lb. to 9 lb. per square inch. The quantity of air required by No. 3 furnace amounts to 25,000 cubic feet per minute, and to heat this amount four stoves are at present being employed.

The Sahlin water-cooled boshes formerly fitted to this and to the other furnaces have recently been superseded by "Spray" boshes. The pig iron, which is a high-grade and remarkably even-grained and homogeneous foundry iron, is open cast in sand beds and lifted by two overhead conveyors by which it is taken to Lowca pig-breaking machines, of which two have been installed.

The boiler equipment consists of eight two-drum gas-fired Babcock and Wilcox boilers evaporating 18,000 lb. of water per hour and raising steam at 160 lb. to 200 lb. pressure. Superheat up to 200 deg. Fah. is employed. A new plant of four three-drum boilers has also been installed capable either of using coke-oven gases, for which they are primarily designed, or for auxiliary oil firing.

The blast-furnace gases are passed into Dick patented dust catchers each 21ft. 6in. in diameter and 51ft. in height lined with 4½in. of fire-brick. As at Park Gate, the dust impinges on a cone, and about 90 per cent. is thus eliminated.



VIEW IN PIPE FOUNDRY

equaliser, while the connections are such that any stove or equaliser can be used at need for any furnace, and either hot or cold blast employed as required. The elasticity of the plant is such that very wide temperature range, varying from that of the surrounding atmosphere up to 1500 deg. Fah., with, on the other hand, a minimum variation when equalisers are in use, is available, and the temperature conditions are therefore completely under control. The dimensions of No. 3 furnace are as follows:—Height, 71ft.; diameter of hearth, 14ft. 9in.; diameter of bosh, 19ft. 6in.; height of bosh (from tuyeres), 11ft. 6in.; diameter of bell, 11ft.; diameter at stockline, 16ft.

The rated output is 1200 tons per week, but this has been exceeded. The burthen is a mixture of Lincolnshire, Northamptonshire and Leicestershire ores containing on an average 30 per cent. of iron, and usually heavily charged with moisture. The coke consumption averages something under 28 cwt. per ton of pig iron produced, the carbon equivalent being about 23 cwt.

As the coke is somewhat friable in nature, and as the ore (which is charged raw) varies considerably in mechanical condition and size, the preparation and distribution of the charge is the subject of special care and consideration. Large lumps are crushed between rollers and revolving tables employed for picking and sizing, while the charging arrangements and the furnace-top construction are similar to those adopted at Park Gate. Charging is effected in skips raised by two steam-driven Otis type hoisting engines supplied with cut-out gear to prevent overwinding, and controlled from a cabin in which, as at Park Gate, the mechanic has before him a model of the furnace top, and can superintend every phase of the charging. The furnace top is of the double bell and revolving

The coke ovens at Staveley represent the very latest by-product coking practice. They consist of an older battery of 100 Simplex horizontal-flue coke ovens, and a battery of fifty Huessener ovens, besides a new plant of 100 Simplex vertical-flue coke ovens disposed in three batteries, making in all 250 ovens capable of coking 12,000 tons of coal per week. The coal used is wet slack containing on an average 12 per cent. of moisture. The plant is equipped with all the necessary auxiliaries, such as coal-handling machinery, storage bunkers, mechanical chargers, coal-crushing plant, and electrically driven coal stamping, charging and discharging machinery, together with a very complete and extensive by-product recovery plant for treating the gases and tar.

The whole installation is one of great interest, particularly in view of the engineering difficulties which had to be surmounted during its construction. The area upon which it was built was in close proximity to seams of workable coal, up to 20in. in thickness, which actually underlay, at no great depth, portions of the site. The ovens were therefore carried on a solid brickwork platform, supported by arches, and an elaborate system of subterranean ventilators had to be adopted to keep the foundations as cool as possible.

It has been said of the modern blast-furnace that its most valuable function is that of a gas producer, with a merchantable by-product—the pig iron. The Devonshire works of the Staveley Coal and Iron Company, in its coke oven and by-product recovery plant, exemplifies the modern tendency for a coking plant to be a chemical works first, and a coke producer only perhaps in a secondary degree. The whole of the coke-oven gases is passed to the recovery plant, of which the sections dealing with benzol alone have an output capacity of 40,000 gallons per week. As the product is treated in its final stages by the Staveley patented desulphurising process, the "sulphur-free" Staveley benzol has established its reputation for well-refined and high-grade qualities.

Sulphate of ammonia is recovered by sulphatation with acid, made by the company in an adjoining sulphuric acid plant, while oleum, a term which has replaced the name Nordhausen acid, for the concentrated fuming sulphuric acid required in nitrating processes, and nitric acid are also manufactured. A new plant has just been installed to increase the output of sulphuric acid for the manufacture of caustic soda by the electrolytic process. Other products made in the chemical plant are bleaching powder, salt cake and muriatic iron; iron oxide for pigment and other purposes (recovered from the spent pyrites used in making sulphuric acid), muriatic (hydrochloric) acid, and various proprietary chemicals, such as Wormite (a fumigant for the soil), and Staveho, a waterproofing cement.

In the by-products recovery plant proper, and in addition to benzol, sulphate of ammonia and tar, the "stock" products of every by-product plant, plant and machinery have been installed for the manufacture of ammonium chloride (sal ammoniac), aniline, and aniline salt; solvent and heavy naphtha; naphthalene, in its familiar commercial forms (crude, pressed, flaked, powdered, and in balls and tablets), anthracene, pyridine, carbolic acid and powder, cresylic acid, green oil, tar, pitch and black varnish.

Staveley cast iron pipes have achieved a world-wide reputation for soundness and staunchness. They are made from cupola metal in the adjoining foundries of the older plant of the works, and cast vertically in capacious beds. The water required for the various operations about the works, including the cooling of the blast-furnace tuyeres, quenching coke, &c., is obtained from the river Rother and from a canal which traverses the works. The pumping plant comprises one 26in. by 30in. hydraulic pumping engine serving the cranes, &c., at the foundries, and several batteries of Sulzer centrifugal pumps, the aggregate capacity of the plant being 13 million gallons of water per day. The generating plant consists of a 3000-kilowatt and a 5000-kilowatt turbo-generator made by the British Westinghouse Company, and driven by exhaust steam from the blast-furnace blowing engines, and a 1000-kilowatt turbo-generator housed in the blowing engine-house. Current is generated at 6600 volts for transmission to the collieries and to various parts of the plant. In addition to the foregoing two Browett Lindley steam engines and generators (1000 kilowatts and 500 kilowatts) have been installed generating 220/240 volt direct current various works' services.

The Gennevilliers Electric Power Station.

No. I.

FROM time to time we have referred to the large electric power station which has been under construction in the village of Gennevilliers, facing the town of Argenteuil, outside Paris, but we have not as yet described the station in full. An extensive publication dealing with the scheme in detail has, however, just been issued by La Revue Industrielle, of 57, Rue Pierre-Charron, Paris, and through the courtesy of the publishers we are now able to give further particulars. The site on which the station has been erected has a frontage of 400 m. (1312ft.) on the Seine, and lies between the railway bridge and the bridge of the avenue of Argenteuil. This situation provides the supply company—the Union d'Electricité—with excellent transportation facilities, both by rail and by water, and assures the supply of fuel under all probable conditions. A wharf about 160 m., or 524ft. in length, which will eventually be extended to 1312ft. permits barges of 1000 tons and over to come alongside the station. The coal storage extends in a direction parallel to the Seine, and is capable of storing 60,000 tons of fuel. The station has been built so that it can be extended in all directions. A large space has been reserved, for example, for the installation later on of 150,000-volt switch-gear, which will constitute the terminals of the hydro-electric power lines. A steam pressure of 25 kilos, (360 lb. per square inch) has been adopted, but the turbines are designed so that they can operate at their full capacity with a pressure of 285 lb. per square inch, the maximum steam temperature being at 375 deg. Cent.

As a result of a careful examination of the results obtained with large generating units both in America and Germany, it was decided to employ sets capable of developing 40,000 kilowatts, for units of this size not only meet the requirements of this particular station, but are also advantageous from the point of view of high efficiency and low operating and initial costs. All the generators are designed to operate at 6000 volts, and they are directly connected to transformers wound to give 60,000 volts on the secondary side, to which all the switchgear is connected. The question of obtaining all-round maximum economy has led to the use of boilers of large capacity. Various

considerations, such, for instance, as the necessity for being able to burn a great variety of different coals, has led to the adoption of a mixed boiler-house equipment. Half the boilers to be installed will be of the Stirling type with Riley stokers, whilst the other half of the equipment will be composed of Babcock boilers with chain grates. At present there are five Stirling and twenty Babcock boilers. The leading particulars of the Stirling boilers are given in the following table, and a drawing of these units is shown in Fig. 1.

Operating pressure	25 kilos. (350 lb. per sq. in.)
Tubular heating surface per unit	2100 sq. m. (22,604 sq. ft.)
Superheater heating surface	1000 sq. m. (10,764 sq. ft.)
Steam temperature	375 deg. Cent.
Steam generation, normal, per hour	60,000 kilos. (132,277 lb.)
Steam generation, maximum, per hour	80,000 kilos. (176,369 lb.)
Guaranteed efficiency, boiler only	75 per cent.
Grates	Riley

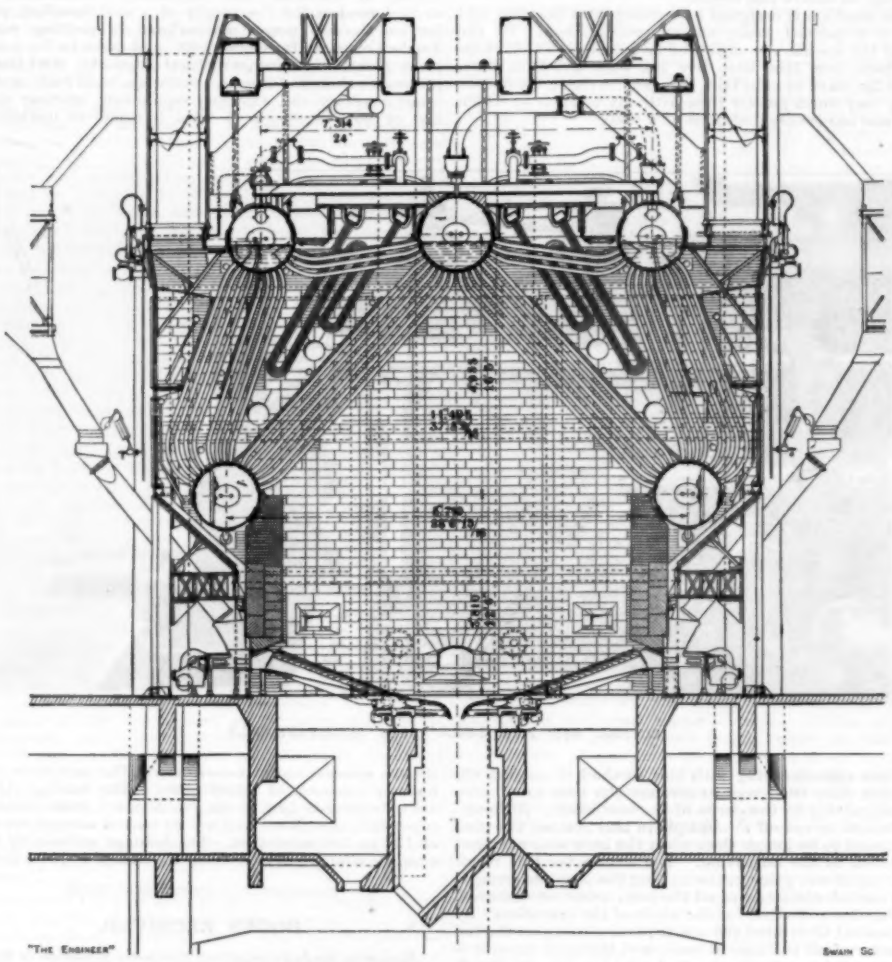


FIG. 1—STIRLING BOILER WITH RILEY STOKERS

The table below gives the leading particulars of the Babcock boilers :—

Operating pressure	25 kilos. (350 lb. per sq. in.)
Tubular heating surface per unit	1330 sq. m. (14,316 sq. ft.)
Superheater heating surface	760 sq. m. (8180 sq. ft.)
Steam temperature	375 deg.
Steam generation, normal, per hour	40,000 kilos. (88,184 lb.)
Steam generation, maximum, per hour	53,000 kilos. (116,844 lb.)
Guaranteed efficiency, boiler only	75 per cent.
Grates	Babcock and Wilcox,

The auxiliaries are operated mainly by electric motors which are connected to the main bus-bars through step-down transformers. As a safety precaution, however, some of the auxiliaries are coupled to turbines which can be run continuously or be brought into use in the case of emergency. As an additional precaution two 3000-kilowatt turbo-generators are provided, each being capable of operating the principal auxiliaries under abnormal conditions or during the night when only one main generator is in service. Each of the main turbines is provided with two bleeders, which enable steam from the intermediate stages to re-heat the condensate. The re-heating is entirely automatic, and at full load the temperature of the condensate is raised to 85 deg. Cent., and at half load to 70 deg. Cent. Exhaust steam from the various feed pumps, which are in constant operation, is also made to re-heat the condensate to the extent of 100 deg. Cent., and a special regulator maintains the desired temperature and avoids evaporation losses. The feed water enters the economisers at the last-mentioned temperature and leaves at a temperature of 160 deg. Cent., and under these conditions the temperature of the hot gases coming from the economisers is approximately 220 deg. Cent. If the heat in these gases was not further extracted a loss of efficiency would arise, and in order to avoid this an air heater is installed in the economiser outlets, the heaters being designed to pre-heat the air going to the boilers to 90 deg. Cent., and to lower the temperature of the gases to a maximum of 150 deg.

The economisers have been designed with a view to reducing the dimensions, the radiation losses, and the cost of maintenance, and are placed on top of the boilers. Although this arrangement has resulted in an increase in the cost of the boiler frames, it has had the effect of considerably reducing the boiler-house area. Each set of economisers comprises a tubular heater and a steel sheet air pre-heater, the latter being designed by the Union d'Electricité in collaboration with Paul Kestner, the Union Thermique, and Emile Prat-Daniel. The heating surface of the economisers is 1200 square metres (12,916 square feet), and the air heating surface 1790 square metres, or 19,265 square feet, the corresponding figures for the economisers and pre-heaters of the Babcock boilers being 1600 square metres (17,220 square feet) and 2240 square metres (24,109 square feet) respectively. The guarantees under normal working conditions are as follows :—

	Deg. Cent.
Temperature of the water at the inlet	90
Temperature of the water at the outlet	150
Temperature of the air at the inlet	30
Temperature of the air at the outlet	90
Temperature of gases at the economiser inlet	340
Temperature of gases at the economiser outlet	220
Temperature of gases at the pre-heater outlet	150

The chimney stacks are of the Louis Prat metallic type.

The present turbine-room equipment consists of five turbo-generator sets, each rated at 40,000 kilowatts, but the station is capable of accommodating six of these units. It is expected, however, that the power-house will eventually be made to take seven or possibly eight sets of this capacity. All the turbines at present in use are of the Zoelly type, and all the parts are identical and interchangeable. Three of the sets were manufactured by the Société Alsacienne de Constructions Mecaniques, whilst the other two sets were built by Schneider and Company and Escher Wyss, the former firm supplying the electrical plant in each case. Each set runs at a speed of 1500 revolutions per minute and generates three-phase 6000-volt current. The guaranteed steam consumptions are 4.37 kilos. (9.63 lb.) at full load, 4.3 kilos. (9.48 lb.) at three-quarter load, 4.5 kilos. (9.92 lb.) at half load, and 5 kilos., or 11 lb., at quarter load. The condensers have a surface of 3500 square metres, or 37,573 square feet.

The condenser pumps are driven by three-phase induction motors, but one pump in each group is provided with a steam turbine for use in the case of emergency. The air extractors are of the steam jet type, and a special jet is provided for starting. The guaranteed vacuum with circulating water at a temperature of 15 deg. Cent. is 96.5 per cent. The turbo-generators are cooled in accordance with the closed circuit system, the same air circulating through the machines continuously and being cooled by a water cooler. The advantages of this system are the recuperation of the heat, the absence of dust in the cooling air, and a reduced risk of fire in the event of a short circuit. As a further precaution against fire a special apparatus has been provided for the purpose of increasing the nitrogen content in the air, so that it will not support combustion. Moreover, in order to provide a supply of cooling air in the event of the main cooling system being put out of action, an auxiliary source of filtered air has been provided. Normally, however, the main filter installation is capable of supplying all the air required by four of the main generators when working at their full capacity. The two auxiliary 3000-kilowatt turbo-generator sets, which have been installed for providing power for driving the auxiliaries, generate current at a pressure of 3000 volts, and run at a speed of 3000 revolutions per minute. The general distribution system for the auxiliaries is a 3000-volt system, and all motors of 50 horse-power or over are wound for this pressure, whilst motors below this power work at 220 volts. Under normal conditions the power for the auxiliaries is supplied from the station bus-bars, the pressure being reduced to 3000 volts by means of step-down transformers. The direct current required in the station is obtained from rotary converters which work in conjunction with a storage battery. In the case of emergency the excitation for the main generators can be supplied either by the battery or by auxiliary exciters.

In the construction of the main buildings and workshops no unnecessary expense has been incurred by providing elaborate ornamentation and luxury, the ordinary lines of architecture having been strictly adhered to. Furthermore, in order to avoid all loss of time and discussions on minor details the company decided not to employ an outside contractor. A special department was established for carrying out the work involved in the construction of the new station.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DOUBLE-REDUCTION GEARED TURBINES.

SIR,—Several articles have recently appeared in your valued paper, and also in other engineering journals, regarding the breakdown of double-reduction geared turbines. It would appear from these articles that the engineers blame the steel makers for supplying them with unsuitable steel, whereas the steel makers seem to think that the engineers are to blame in not allowing for the loads which come upon the teeth.

We have spent some considerable time investigating this matter and have examined the steel supplied to us for a very large number of pinions, including some pinions which have failed under working conditions, and up to the present time we have been unable to find any single instance in which we could say definitely that the steel in the former case was likely to cause failure, and in the latter case had actually caused breakage of the teeth.

In our opinion the cause of the trouble is mainly mechanical. We have now completed twelve vessels fitted with double-reduction geared turbines of the Parsons type, with powers ranging from 3000 to 4600 shaft horse-power. Several of the ships are oil tankers, having the machinery placed aft, which is the worst condition for geared turbines, and in only one case has there been any trouble with the gearing. In this case the vessel is an exact duplicate of a ship built by us, which has been running successfully for nearly two years, the only difference being that the gearing was cut by different firms.

On the sea trial of this vessel there was unusual vibration in the gear case and noise in the gearing quite unlike her sister ship. On her maiden voyage two low-pressure primary pinions were broken and the low-pressure primary wheel was damaged. A new pinion and wheel were prepared and cut by the same firm that had cut the gearing for the sister ship which is giving satisfaction. This new pinion and wheel were sent to the vessel at a port abroad and fitted there, immediately after which the noise and vibration on this side of the gear case was found to have disappeared. The vessel has now returned to this country, and a new wheel and pinion are being fitted to the high-pressure side, which we are convinced will eliminate the remaining vibration and noise.

We have also had experience with another vessel in which the gearing was somewhat noisy, and there was a considerable amount of vibration. The gearing was removed and the wheels examined, when it was found that although the teeth were all of the same thickness there were slight inequalities in the pitch at different parts of the circumference of the wheel. The wheels in question had been cut on a machine which had no creep mechanism. They were re-cut on a machine fitted with creep mechanism, and the ship was taken to sea for trial, when the vibration was found to have completely disappeared and the noise was very much less.

It has been suggested that the gearing should be in separate gear cases rather than interleaved. We are of the opinion from our experience that there is very little in this suggestion, as three of these twelve ships had three box gears and ran no better than the remaining nine, which were fitted with interleaved gearing.

With regard to the strength of the teeth, although we are prepared to agree that teeth of $^{7}/_{10}$in. pitch may be strong enough theoretically, we are strongly of the opinion that the pitch of the teeth should be not less than $^{9}/_{10}$in. for the first reduction gearing, and 1in. for the second reduction gearing, to add sufficient body to the teeth to allow for the momentary heavy loads which come upon them, and which are evidently not calculable, and also to allow for pitting and wear.

We were the first firm to introduce the low load per lineal inch on second reduction gearing, which in turn introduced a heavy fly-wheel, which counteracts the torque of the propeller, and we are firmly of the opinion that the success of our gears is largely due to this provision.

If the foregoing points are attended to and the gearing is cut on an accurately built machine fitted with creep mechanism, we are quite confident, speaking from actual experience obtained of eleven different vessels fitted with double-reduction gearing, that double-reduction gearing should run satisfactorily and give the results which have been expected.

We consider that nickel steel is the most suitable material for pinions, if special care is taken with the heat treatment, and after the investigations of the steel makers which have been recently carried out, there is no doubt that we will get an even more satisfactory steel in the future than we have obtained in the past.

We have had an opportunity recently of measuring the steam consumption of one of these double reduction geared turbines, and the results show a saving of 23 per cent., as compared with a triple-expansion job under similar conditions, which we consider shipowners should not lightly throw away.

PALMERS SHIPBUILDING AND IRON CO., Ltd.
Hebburn and Jarrow-on-Tyne,
September 2nd.

DIESEL ENGINE PATENTS.

SIR,—I was much interested in reading in THE ENGINEER Captain H. Riall Sankey's views regarding "What Constitutes a Diesel Engine," based on Dr. Rudolf Diesel's original patent specifications No. 7421 of 1892 of the British Patent Office. Captain Sankey and other engineers should disregard this particular patent specification, which is the master patent, taken out in 1892 before Dr. Diesel made his conclusive patents.

The true Diesel cycle as now world-widely used is based on the second engine, which commenced its four-year test in 1896, and which had air injection of fuel. The original engine had airless injection, and only made a few revolutions when it blew the indicator to pieces. To be exact, the fundamental features of the true Diesel principle is a heavy-oil or coal-dust burning internal combustion engine, having the following characteristics:

(1) Compression of pure atmosphere to a degree that the temperature produced is adequate to the inflammation and combustion of the fuel.

(2) Injection of fuel at such a rate that the burning proceeds without rise of pressure on combustion space. This condition is not realised with absolute precision, there always being a slight rise of pressure when the fuel begins to burn.

(3) The injection of fuel by air blast that produces turbulence needed for good combustion. This is essential, but not distinctive or exclusive to the true Diesel cycle.

An engine is either a Diesel engine or it is not a Diesel engine; hence the terms "full-Diesel," "semi-Diesel," virtually mean nothing. There are, however, several recognised variations of the Diesel engine which come within the Diesel type limits, as they are modifications of the Diesel principle.

THOS. ORCHARD LISLE.
New York, N.Y., August 23rd.

GLIDERS.

SIR,—The recent successful experiments in the art of gliding are very interesting, inasmuch as they suggest and provide a means of restarting the science of aeronautics upon a fresh basis. Although the mere fact of being able to glide for a period of two hours at a stretch under the most favourable conditions may not be of real practical service when it comes to working under average conditions, the experience and knowledge gained by such experiments should be of value in leading towards a reconsideration of the best means of propulsion. It seems obvious that the addition of comparatively small propulsive power would be needed to promote sufficient forward motion to enable the glider to progress through still air and to keep up flight for as long as the power could be maintained, but, so far, no suggestion seems to have been made as to the easiest and most obvious means of fitting the gliders with any simple auxiliary power. Earlier experiments were unfortunately diverted by the success obtained through the use of the fan propeller, driven by oil or petrol power engines. It must, however, be obvious to anyone taking an interest in aeronautics that such method of propulsion is absurdly expensive, as well as wasteful of power, and should indicate that the method itself is wrong in principle. If a glider can keep up for several hours without power, it is surely ridiculous that an aeroplane should have to be fitted with engines of from 100 to 1000 horse-power. If a bird can fly with its own power, surely a man ought to be able to do so with about 1 horse-power, provided, of course, that such power be applied on a similar principle. Scores of centuries have evolved in the form of the bird's wing and in the fish's tail the most perfect and efficient methods of propulsion through air and water, and yet we make no use of the example provided—not for want of trying, I admit, but for want of perseverance. We should therefore fit the glider with a contrivance which would work on the same principle as a bird's wing, and this might consist of planes made to move up and down with flexible extensions, or fixed planes with movable and flexible extensions. The flexibility of the extensions is essential to secure the action of pushing backwards against the air, brought about in the case of the bird by the giving way of the feathers at the back of the wing. Balancing and guiding should be supplied by means of a tail, also based on the pattern of a bird's. Theoretically, there is no reason why the action of a dragon fly or bee should not be imitated.

The point which I wish to emphasise is that we want to hark back and restart progress on new lines, and that the recent attention paid to gliding not only gives the opportunity of so doing, but also suggests the simple means of evolution in the right direction. I shall, of course, be told that it has already been tried and found impracticable, but it would be foolish to accept this as final in view of nature's success, combined with the evidently wrong principle of propeller compulsion, conducing to so many accidents in the act either of ascending or descending and in other ways.

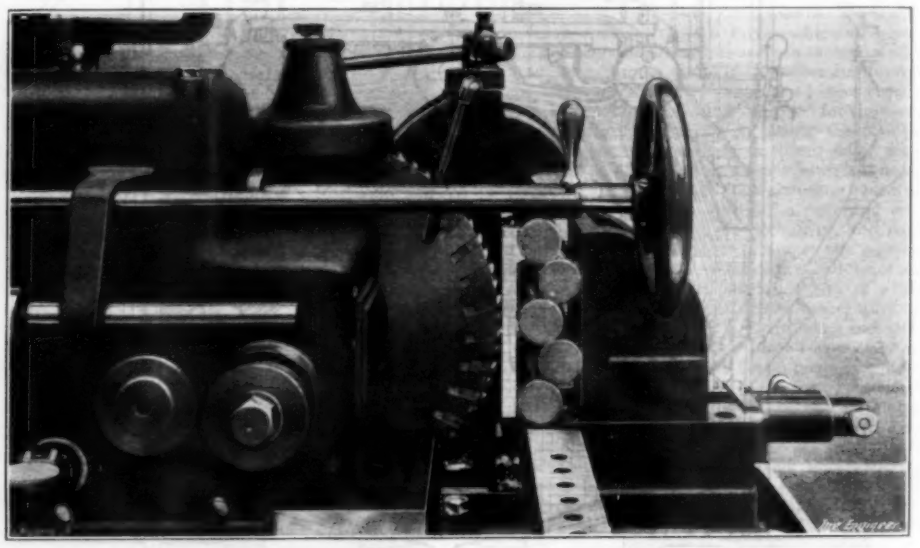
September 1st. ECONOMIST.

New Method of Cutting Off Bars.

A NEW method for cutting off steel bars has recently been introduced by Alfred Herbert, Limited, of Coventry. In many workshops the cutting off of blanks from the bar is an uneconomical process, particularly when large numbers of blanks of one size are to be cut off. In order to overcome this difficulty Messrs. Herbert have introduced the method shown in the engraving.

The machine is the firm's 6in. circular cold sawing machine, provided with the patented revolving chip remover, which we illustrated in our issue of September 17th, 1920. The novel feature of the machine consists of the vice, which has two jaws, one moving horizontally and one vertically. The horizontal jaw is very tall in proportion to its width of opening so as to accommodate a stack of bars, as shown in the engraving, the gripping being done by the vertical jaw. When arranging the vice for a given size of bar, the horizontal jaw is set to the required dimension, which is known beforehand. The bars will then rest in the vice in such a way that when the vertical jaw is tightened every bar will be gripped with equal force, the staggered arrangement of the bars providing for their relative movement when being gripped, in order to ensure this result.

The machine is designed for cutting off a 6in. bar, and will, it is claimed, easily cut off two 5in. bars. By the use of the special vice it can be arranged to cut off three 4in. bars, four 3½in. bars, five 3in. bars, five 2½in. bars, seven 2in. bars, or nine 1½in. bars, and so forth, the output being very much greater than with any method by which only one bar is operated upon at a time.



CUTTING OFF FIVE 3-INCH BARS SIMULTANEOUSLY

When experimenting with this method of cutting off, the first plan tried was to arrange the bars in a curve approximating to the curve of the saw blade. Although bars could be cut off in multiple in this manner the time was found to be longer than when the bars were arranged as shown in the engraving. The reason for this result was that at one point in the cutting the saw was engaged with the full diameters of all the bars, a fact necessitating slowing down the feed for the whole of the operation. By the method illustrated the saw is never cutting on the full diameter of all the bars at once, and the work upon it is therefore lightened so that a faster feed can be employed. We give below particulars of times—supplied to us by Messrs. Herbert—in which various sizes of bars can be cut off, the bars in question being of good quality mild steel, and the inserted tooth saw having high-speed steel teeth.

Diameter of bar, inches.	No. of bars cut at one pass.	Rate of feed, inches per min.	Cutting time. Min. Sec.
4	3	¾	9 45
3½	4	¾	10 15
3	5	13/16	7 0
2½	5	13/16	5 0
2	7	1	3 50
1¾	8	1¼	3 45
1½	9	1¼	2 30

Application has been made for a patent for the vice and the method of stacking, the great advantage of which is that no special preparation need be made when changing from one size of bar to another. It will be noted that the saw cuts in the upward direction, the object being to keep the pressure downwards upon the slide along which it traverses.

ELECTRICITY ENTERPRISE IN AUSTRALIA.

AFTER a lengthy investigation, the Victorian Electricity Commission has formulated a scheme for utilising the hydraulic resources of the State. While moderate in extent and cost, it will economically serve a large rural area, and at the same time form a useful and advantageous adjunct to the heat-power schemes at present in course of development. Based on the Sugarloaf reservoir, on the Goulburn River, the project when completed will serve with electric power such widely separated points as Echuca, Shepparton, and Albury. The whole of the present probable electric power consumption of this territory has been found, after a careful power survey, to amount to about 6,000,000-kilowatt hours per annum, with an assured prospect of an increase within a very few years to more than double this figure. There will be five power houses, all of which will feed into a common sub-station, situated about eight miles from Sugarloaf whence transmission lines, operating at 66,000 volts, will run to the various power centres, and also connect, on the northern outskirts of Melbourne, with that city's high-tension network from Morwell. The estimated cost of the scheme in its entirety is £962,320, including £618,870 for the hydraulic and electric works and appurtenances at Sugarloaf. The estimated costs of energy delivered in bulk are about 0.30d. per kilowatt-hour for 22,000 volts, and less than 1d. per kilowatt-hour for 6600 volts. Provision is made for the scheme to be completed by 1927, and the Commission has recommended that work on the transmission lines should be first proceeded with, and the total cost spread over the five years as follows:—1923, £50,000; 1924, £312,850; 1925, £115,000; 1926, £272,000; and 1927, £212,470.

In connection with the generation and distribution of electric light and power from the Morwell fields of brown coal, it is officially stated that the extension of electric supply to towns on the Mornington Peninsula and in the Yarra Valley is approaching completion. High-tension feeder lines have been erected, but it is pointed out that they are merely an anticipation, and form part of the future network of high-tension distribution in Victoria. The Electricity Commission has invited tenders for the supply of a coal handling plant for its Morwell power station and briquetting works. Tenders close on December 16th, and must be for a complete plant, including structural supports, steel-framed protective shelters for gear, platforms, hand rails, and all other auxiliary and accessory equipment, whether specified or not, necessary to form a complete installation for the conveyance of brown coal. The coal store must have a capacity of 10,000 tons. The haulage trucks are to be steel-bodied, of the double-sided, gable-bottomed type, with side doors, and are to have a normal capacity of 150 to 200 cubic feet. The haulage cable is to have a tensile strength of from 90 to 100 tons per square inch.

BOOKS RECEIVED.

Report on the Industrial and Economic Situation in Greece. By E. C. D. Rawlins. London: His Majesty's Stationery Office. Price 2s. net.

Mechanics. Part I. By George Thompson and G. H. Leslie. London: Cassell and Co., Limited, La Belle Sauvage, E.C. 4. Price 2s. net.

Machine Tool Operation, Part 2. By H. D. Burghardt. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 13s. 9d. net.

Practical Accounting for General Contractors. By H. D. Grant. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 15s. net.

The Design of Masonry Structures and Foundations. By C. C. Williams. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 25s. net.

City and Guilds of London Institute, Department of Technology: Programme for the Session 1922–1923. London: John Murray, Albemarle-street, W. 1. Price 3s. 6d. net.

Production Engineering and Cost Keeping for Machine Shops. By W. R. Basset and Johnson Heywood. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 17s. 6d. net.

Sammlung Göschen Elektrotechnik Einführung in die Starkstromtechnik. I.: Die Physikalischen Grundlagen. By Professor J. Hermann. Berlin, W. 10: Vereinigung Wissenschaftlicher Verleger, Walter De Gruyter and Co Price $ 1.6.

The British Engineering Standards Association, No. 153, 1922, *Parts* 1 *and* 2: *British Standard Specification for Girder Bridges. Part* 1: *Materials. Part* 2: *Workmanship.* London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

The British Engineering Standards Association, No. 96, 1922: *British Standard Specification for Parallel-sided. Carbon Brushes for Direct-current Commutator Machines.* London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 1s. net.

Railway Matters.

WE regret to have to record the sudden death, on the 2nd instant, of Sir Francis Gore-Browne, K.C., who was the chairman of the Railway Rates Advisory Committee and subsequently the President of the Railway Rates Tribunal.

THE Commissioners of the Victorian Government Railways have formed a separate signal and telegraph branch independently of the way and works branch. The engineer of signals, Mr. F. M. Calcutt, has been appointed chief engineer of signals and telegraphs.

IN his report on an accident to a bridge painter and rigger, employed by the North British Railway Company, who fell off the Forth Bridge into the Forth and was drowned, Mr. J. P. S. Main, of the Ministry of Transport, says that the possibility of equipping men with some form of air waistcoat or collar, which will not in any way impede or hamper their movements when engaged upon such work, is worthy of consideration.

ON March 31st last, we mentioned that the *Railway Gazette* had suggested that the next congress of the International Railway Association should be held in London, in 1925, to celebrate the centenary of the opening of the Stockton and Darlington Railway. We now learn from our contemporary, that although the next congress is fixed for Madrid, in 1927, a meeting of the Association is to be held in London in the second half of the year 1925.

IN this column of our issue of July 7th, we referred to the issue of the Ministry of Transport "commodity statistics." Further statistics, price 3s. 6d., have now been issued of other commodities, of which the most interesting are coal, coke, and patent fuel. The average length of haul for "shipment" is only 22.60 miles, as against 58.58 miles for home consumption; but shipment coal brings in 1.51d. per ton per mile, as compared with 1.23d. for home consumption.

THE placing of contracts for the electrification of the Central Railway of Brazil is not proceeding as quickly as the Government could desire, while the class of bids so far received, it is said, has not afforded the highest satisfaction. Of the offers submitted four alone have been taken into consideration by the Government. These have been divided into six groups, including overhead distribution, sub-stations, locomotives, cars, signals system and sheds and shops. Notice of the awards has yet to be received.

WHEN the Great Northern, Brompton and Piccadilly—Finsbury Park to Hammersmith—section of the London Electric Railways is extended, under the Act of 1913, to join the London and South-Western's branch from Addison-road to Gunnersbury, the two South-Western lines and the two Metropolitan District lines will be re-arranged so that the District trains will run on the outer lines and the London Electric and the South-Western—if the latter company again runs trains from Addison-road—will run on the centre. The two up lines will thus be together and the two down.

A SETTLEMENT of the dispute which rendered the Clyde Engineering Works (N.S.W.) idle, throwing 1000 workers out of employment, is reported. The company was carrying out a contract for the State Ministry for the construction of 300 locomotives at an estimated cost of £7900 each. As the first thirty engines delivered averaged £10,000 each, a difficulty arose, and the plant was closed down. The new contract between the company and the Railway Department of New South Wales will not exceed £500,000 for the supply of about sixty locomotives, and will occupy the works for another two years. The new contract will be based on current prices and wages, with a rise-and-fall clause to govern variations during its currency.

JUDGMENT has now been given by the Industrial Court on the question of shopmen's wages, referred to on page 200 of our issue of August 25th. On July 8th last the Court decided that certain changes should be made after October 1st, 1922. Subsequent to this the men in the engineering trades had their bonus reduced, and because the bonus of the railway shopmen has hitherto been closely related to that in the engineering trade the railway companies contended that this applied to their men also, and that their bonus could be reduced before October 1st. The Court, in its judgment of July 8th, decided that railway service was an industry in itself, and that it was not desirable to impose on the companies and the employees an obligation to adopt and follow the rates of wages agreed upon or recognised by employers or workers in other industries employing similar classes of labour. The Court has now decided that it would not be consistent with this underlying principle that a reduction in the railwaymen's bonus should be made simply as a consequence of reductions in another industry, and that therefore no change is to be made before October 1st.

THE standard facing point lock in use on the North-Eastern Railway was designed by the company's former chief engineer, Thomas E. Harrison, who was president of the Institution of Civil Engineers in 1873-74. The points, locking bar, and the wedges which hold the switches in position—one open and the other against the stock rail, were at first moved by a motion plate. Later, the wedges were put in the rim of the signal wire from the signal-box to the signal, so arranged that, unless they were shot, the signal could not be lowered. These locks had, however, the weakness that they could not be detected—*i.e.*, the signal could not detect the points and ensure that they were set for the same direction as that for which the signal was lowered. They have, therefore, been discarded in new work for some years. Some are still to be found in York yard, and one led to a derailment there on June 1st last, as to which Major Hall has reported. The switch rails had crept, and instead of the wedges withdrawing ¼in. clear of the toe of the switch, they were 2¼in. clear. This clearance, with the spring and play at the joints, allowed the wedge lever to be moved when the points were "gaping" owing to the blade of a grease knife being between the switch and the stock rail. An approaching passenger train struck the points and was derailed.

Notes and Memoranda.

A PAPER read recently before the Birmingham Metallurgical Society gave details of a number of experiments made to test the assertion that high-speed steel will continue to cut when at a red heat. The experiments showed conclusively that high-speed steel will not cut at a dull red heat; that is to say, it did not do so at 500/550 deg. Cent., which is a red heat visible in a poor light.

THREE minutes' smoke per hour, states Mr. W. H. Casmey in the *Fuel Economy Review*, indicates a loss of 1 per cent. of the fuel used during that time, so that a firm whose boilers are burning 2 tons of coal per hour and the chimney emits smoke for nine minutes, loses 134 lb. of coal per hour, or for a week of fifty hours the loss is 3 tons, so that if three boilers were using the 2 tons of coal mentioned, the loss from smoke alone would be at the rate of 50 tons per boiler per year. Great as this loss is it is small in comparison with that produced by excess air, and which is also the chief cause of black smoke.

BEFORE the war, states the *Ironmonger*, there were occasionally reports of new processes for making steel direct from ore, but during the last three or four years a considerable number of patents has been taken out in various countries. One of the latest comes from France under the name Levoz. A trial has recently been conducted at the Heches Works, in the Pyrenees, by the Société des Usines Ste.-Marie et Gravigny, which is stated to bear out all M. Levoz's theoretical forecasts. Using Pyrenees iron ore, M. Levoz obtained a steel by a direct electric-furnace method running: carbon = 0.98, manganese = 1.17, silicon = 0.25. It is claimed that this steel, the composition of which shows it to be a hard steel, is not brittle as is usually the case when made in the ordinary way, but is as ductile as a soft steel, though it can be hardened like a high-speed steel. The metal is so fluid that machine parts can be cast with no trace of blowholes. As to cost, 450 kilowatt-hours were required to melt half a ton of metal.

DURING a systematic research upon the heating of fine wires, Professor Imhof, of Winterthur, noticed a curious phenomenon when he used alternating current as a heating agent. Fine wires, stretched between clamps, and heated to incandescence by alternating current, were found to exhibit transverse vibrations of a considerable amplitude. The nature of the vibrations depends upon the frequency of the current, the section and length of the wire, the composition of the wire, and the tension of the wire. Thick wires do not vibrate; wires of metals with a high coefficient of thermal dilatation vibrate with a greater amplitude than wires of less expansible metals. The cause of the effect has been definitely ascertained to be the periodic cooling caused by the passage of the current through the zero value twice in each cycle. Every time this occurs, the radiation and consequent cooling of a fine wire are sufficiently rapid to set up a contraction. These contractions, repeated periodically, build up until they give rise to a periodic vibration of considerable amplitude.

PRODUCTION from low-gravity oil wells can be increased 100 per cent. through the application of electric heat, says the *Journal of Electricity and Western Industry*. A recent test at one of the Californian oilfields in the case of a low-gravity or "head" well demonstrated the feasibility of the scheme. A 5-kilowatt heater consisting of four sections was placed around the well casing before the pumping commenced. Actual measurement showed an increased production of from 50 to 75 per cent. In the case of a 10-kilowatt heater production was increased 100 per cent. It was determined that the cost of operating such a heater averaged £4 per month per well. Low-gravity or "head" wells can usually only be pumped approximately eight hours out of twenty-four, but the application of the electric heater greatly increased the pumping period. It is believed that there are unlimited possibilities in the application of electric heat to oil production in low-gravity districts, not only in pumping from the wells, but also in transporting the oil from the field to the refinery or to the shipping point.

AMONG the hydro-electric schemes proposed in India there is that known as the Bhatkal electric scheme. The idea is to harness two or three of the rivers that fall into the sea in the vicinity of Bhatkal, the site of the proposed Mysore harbour. There are two waterfalls of 800ft. and 500ft., the former ten miles east of Bhatkal and the other two miles south. The two rivers unite at the bottom of the ghats. It is calculated that there would be an effective head of 1400ft. from the larger, and 1000ft. from the smaller. In few parts of India is there such a natural advantage. There is an average rainfall of over 300in. in this district, and the engineer responsible for the suggestions considers that 250in. may be taken as the working basis. The scheme as worked out would provide at least 40,000 horse-power. The main difficulty, according to *Indian Engineering*, is the question of storage, which would need to be not less than 4700 million cubic feet. There are excellent sites for dams, but the scheme would need to be worked out more in detail before definite judgment could be passed on it.

THE Canadian Dominion Fire Commissioner informs the *Electrical News* that new fire risks have been introduced in consequence of the growth of wireless telephony among amateurs. Fires are caused by lightning, and by the use of lighting circuits in connection with the system. Accordingly, a set of rules has been drawn up to guard against the fire risk which now prevails. Among these regulations is one forbidding the erection of antennæ over any other circuits operating at 600 volts or above. Leading-in wires must be of a non-corrosive metal, and in no case smaller than No. 14 B. and S. gauge. These wires must not come within 4in. of electric light or power wires unless separated by adequate insulation. Each leading-in wire must be provided with a protective device which will operate at 500 volts or less. Details as to earthing and earthing wires follow the usual lines. Wires inside buildings must not be placed within 2in. of lighting or power wires unless separated by insulation, such as porcelain tubing. The Committee which drew up the regulations expressed the opinion that there was no danger of fire in installations employing indoor antennæ.

Miscellanea.

COMMERCIAL motor vehicle parades, held under the auspices of the Commercial Motor Users' Association, will be held at Liverpool on September 30th; Manchester on October 7th; and Preston on October 28th.

A MEETING of the Clyde Trustees was held recently at which the question was raised of preventing the emission of thick black smoke from steamers in Glasgow harbour. The matter is to be referred to a special committee, which will submit a report on "the best method of preventing the smoke nuisance."

A CHINESE company proposes to construct good roads between Fowlianghsien and Hukow of Kiangsi. According to *Motor Transport*, a long-distance motor vehicle service will be maintained after the complete construction of the roads. This scheme, when carried out, will facilitate to a great extent the transportation of goods from Kingtechen, Kiangsi, to various parts of China.

THE Commercial Secretary to H.M. Legation at Christiania has forwarded to the Department of Overseas Trade a list of Norwegian agents seeking connections with British manufacturers and exporters of a large variety of commodities, including textiles, chemicals, hardware, coal, iron and steel, provisions, &c. Interested British firms or individuals who are desirous of appointing agents in Norway should make application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1 (quoting Reference Number D.O.T./F.R./5840).

WITH a view to assisting a local company to establish the electricity meter industry in Australia, the Electricity Department of the Sydney City Council paid £3188 in excess of the market values ruling for meters at the time the orders were placed. The Council has a further order under consideration, but the price is 7s. per meter above the price at which similar articles were quoted in England on June 30th last. A director of the local company has stated that he expects a duty of 27½ per cent. to be imposed on electricity meters imported from England and 40 per cent. on imports from America.

WE hear that Short Bros., of Rochester, the seaplane builders, have constructed a hydroglider; a very interesting craft of small size. The boat is some 26ft. in length overall with a beam of 9ft. 6in., and depth of 1ft. 10in. On trials with four passengers and a driver and mechanic on board a speed of over 40 miles an hour was attained. In that condition the displacement of the boat was 4380 lb., and the draught 4in. when going full speed. The power plant consists of a Beardmore 160 brake horse-power six-cylinder aero-motor developing full power at 1200 revolutions per minute. The hull is built of mahogany and is of the two-step design.

A REPORT on the economic and commercial situation of Austria up to July of this year states that the agricultural implement factories are still doing well. The motor car factories were among the first to feel the slump. This branch has been very much enlarged since the war, and as few Austrians can now afford to keep cars nine-tenths of the production is for export. About 4000 cars were produced in 1921. Prices were not raised sufficiently fast to keep up with the fall in the exchange, and in the winter a good six-cylinder car could be obtained in Vienna for the equivalent of £250. A shortage of working capital is the result. The general machine industry is still suffering from German competition, though to a diminishing degree.

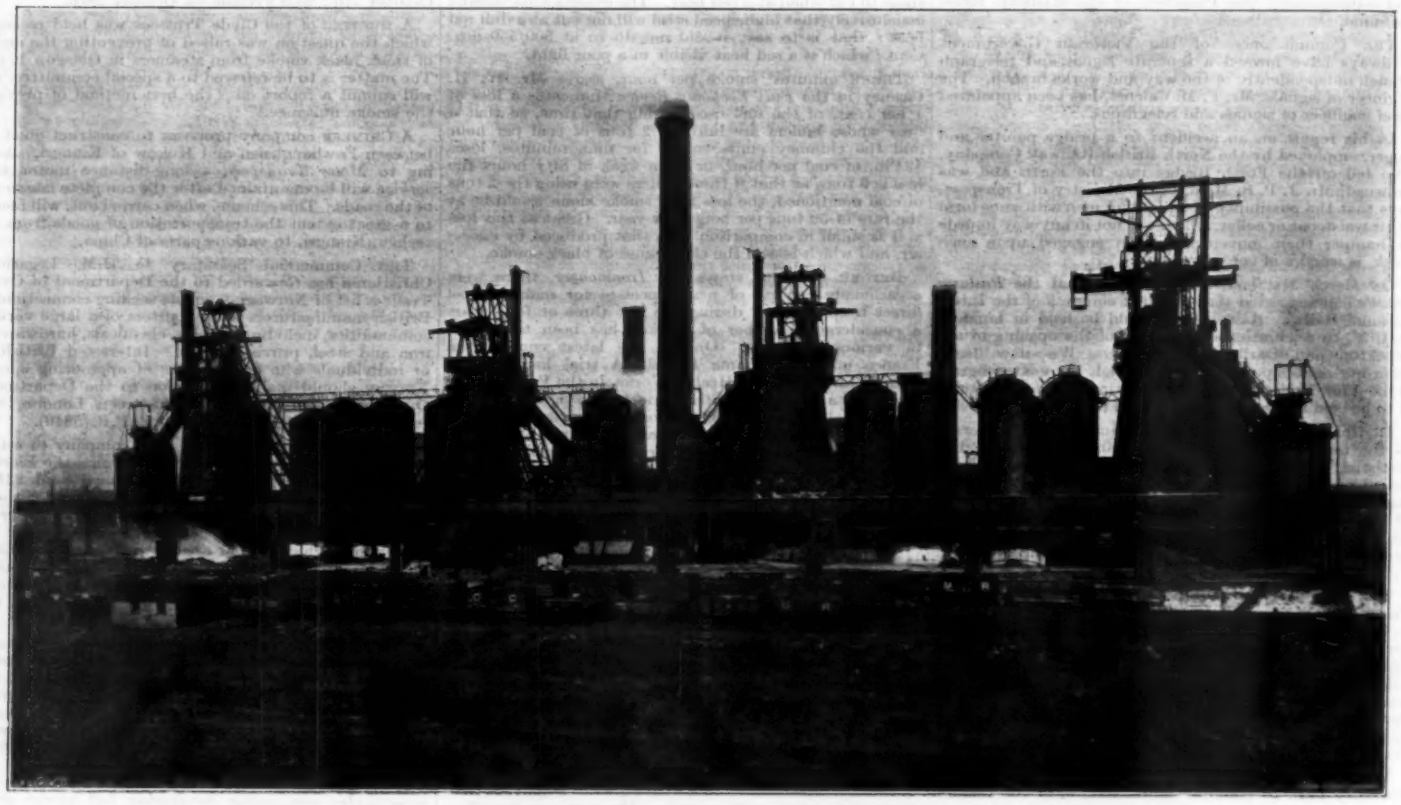
IN view of the recent discussion in connection with the placing of an order for tramway rails in America by the Corporation of Glasgow and the questions then raised as to the rates of pay and conditions of working in American steel works, it may be noted that the United States Steel Corporation recently announced that the wages of day labourers would be advanced 20 per cent. on September 1st. This advance means that the scale for a ten-hour day will be increased from 3.00 dols. to 3.60 dols. Many of the men work twelve hours a day, and in this group the advance will be from 3.60 dols. to 4.30 dols. per day. It is estimated that from 156,000 to 220,000 of the workers employed by the United States Steel Corporation will be affected by the advances.

WITH commendable enterprise the forest authorities of the Federated Malay States are giving the users of commercial woods an opportunity of making personal acquaintance of the products of the Malayan forests. A few cabinets of samples have arrived at the offices in Cannon-street of the Malay States Information Agency, where they may be obtained. Each cabinet contains seventy samples, 4in. by 3in., and ¼in. thick. Each sample is named and initialled by Dr. F. W. Foxworthy, Forest Research Officer, F.M.S. They are smooth but unpolished, and it is thus possible to appreciate the beautiful grain of some of the woods and to judge their suitability for cabinet or other woodwork. A full description of the woods is given in Dr. Foxworthy's bulletin, "Commercial Woods of the Malay Peninsula," also obtainable at the Agency. The bulletin contains other information likely to be of service to users of wood.

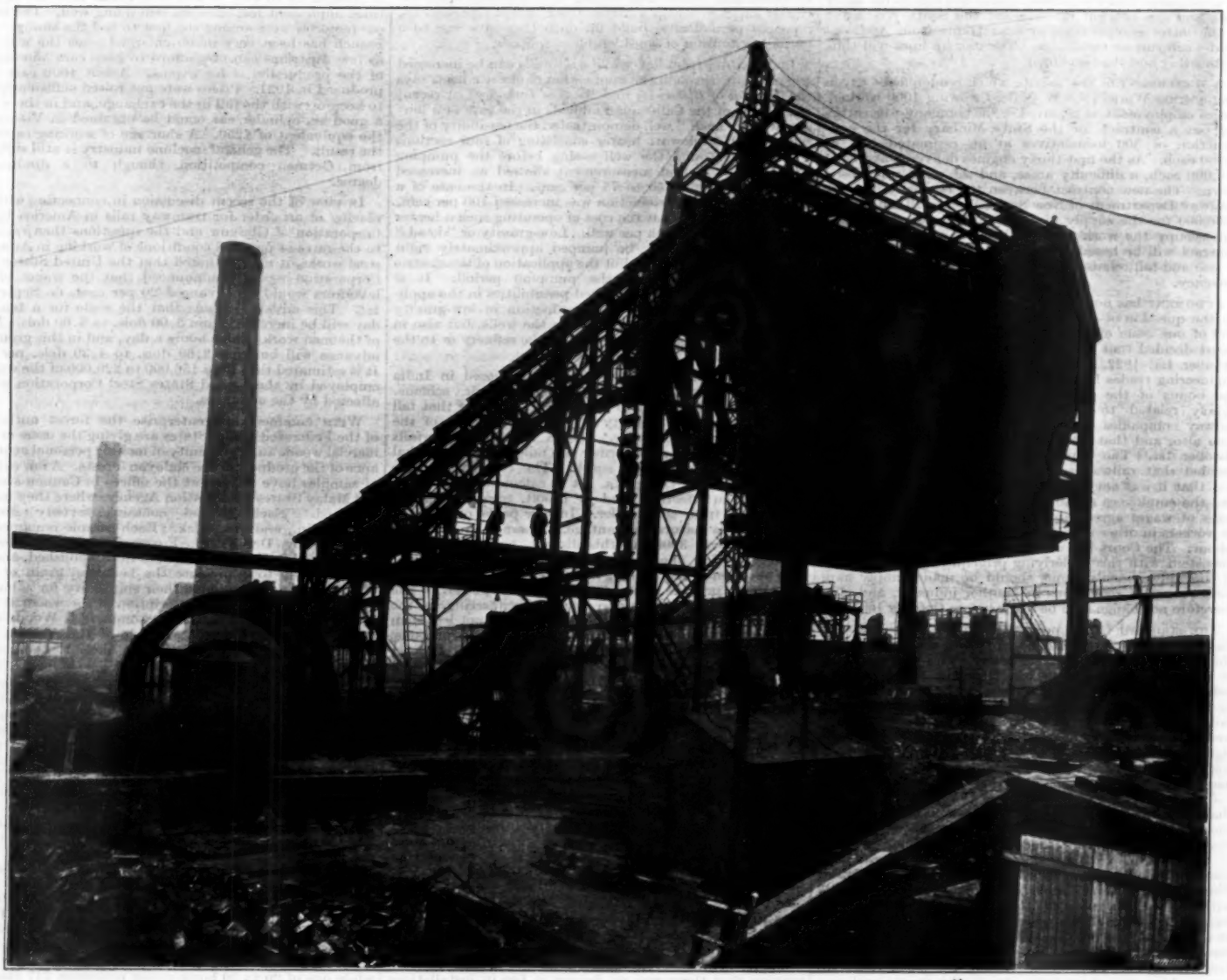
OWING to the high price of fuel in France at the present time the Mechanical Arts Committee of the Société d'Encouragement pour l'Industrie Nationale has thought it desirable to publish an account of the present position of the semi-Diesel engine, and in consequence a recent issue of the *Bulletin* of the Society contains an article of nearly 100 pages on the subject from the pen of M. A. Schubert. It goes into the theory of the engine, the reasons which have led to its development, the forms which it at present takes in France and in other countries, and the oils which can be used in it. Under the last head the author deals especially with the vegetable oils which are produced in great quantities in the French Colonies in Africa and in Asia. It concludes with a short account of the tests of such engines carried out recently by the Society in conjunction with the Automobile Club of France and the marine and agricultural authorities. Several engines of horse-powers from 2½ to 50 show a consumption of oil of the order of 320 grammes per horse-power hour, while one of 20 to 30 horse-power consumes 247 grammes only.

THE DEVONSHIRE IRONWORKS AT STAVELEY

(*For description see page 242*)



GENERAL VIEW OF BLAST FURNACES



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THE ENGINEER.

SEPTEMBER 8, 1922.

Marine Motor Design.

MANY modifications in design were found to be necessary when the early type of steam engine was altered and adapted for use on board ship, and in perfecting the marine steam engine for naval and mercantile service, a large contribution to the advancement of engineering science was made. The reciprocating steam engine has now been followed by the steam turbine, a type of prime mover which, thanks to the pioneer work of Sir Chas. Parsons, received some years after its inception, an impetus in the direction of marine design. The Diesel oil engine was first designed as a stationary engine, and many of the engines installed in the early Diesel driven vessels bear distinct traces of land design. Within the last few years, however, very definite marine types of Diesel engine have been evolved, and the present designs of the leading makers clearly show that conditions afloat have been appreciated, and in most cases fully provided for. The hot-bulb engine—mis-called semi-Diesel—does not perhaps, as yet, possess such marked marine characteristics as its forerunner, but there is evidence that the makers of this type of prime mover are now giving increased recognition to marine requirements as regards both its design and its arrangement in the ship.

The marine petrol engine for comparatively low powers covers a large field, and it has been the object of experiment and trial for many years. The results obtained with early marine type racing engines largely influenced the design of the racing car, which in turn beneficially affected the type of motor which is now most generally in use in our touring and commercial cars. The aero-engine, too, owes much to the experience which was gained with the two types of high-speed engine previously mentioned, for it was evolved from those engines after defects had been eliminated and running reliability increased. It is of interest to note that the aero-engine has in recent years been used with success in racing boats of the gliding or skimming type. When speaking of the marine motor, however, we have more especially in mind those engines which are intended for use in open or semi-open boats. Mr. A. F. Evans, whose paper on "Marine Engine Design as affected by Lifeboat Service Conditions," elicited interesting and vigorous discussions at both the London and provincial meetings of the recent session of the Institution of Automobile Engineers, sums up the requirements of the marine motor as follows:—"The motor and all its fittings should be entirely waterproof and submersible at least to the carburetter intake, and there should be no hot parts which are liable to burn clothing. All hand oiling should be eliminated, and all moving parts enclosed, protected, and lubricated. The engine should be a self-contained unit along with its reversing gear which should be lubricated from the same source as the engine. The design should be such as to give complete accessibility to all adjustable and renewable parts; moreover, it should be as compact as possible, and should incorporate first class automobile engine work. Finally it should be possible to leave such an engine uncared for for quite a considerable time under adverse conditions without detriment to its starting and running qualities." In recounting the efforts which the Lifeboat Institution has made to obtain a marine engine to meet its needs, and in describing the engine which that society has designed and built to suit the arduous demands of lifeboat service, Mr. Evans made a somewhat trenchant criticism of the British marine motor as manufactured for commercial and pleasure services. There are no two opinions concerning the desirability of the requirements just quoted, but the difficulty of the commercial manufacturer would seem to be that the user does not willingly pay for the extra value of workmanship and accessories which of necessity belong to such an engine. Since the war there has been a marked decrease in the demand for expensive engines, and a great deal of the trade to-day is in engines of comparatively low power, which are produced under conditions of manufacture which make for the rapid construction of a large number of units of the same size and type with a corresponding decrease in the cost, both of the whole and of the spare parts. Happily, it is possible even in such engines to embody the essential qualities of marine design, and while effort in this direction is honestly made, we need not despair of the future of the British marine petrol engine. There is, moreover, certainly a place for high grade engines of larger power, although, owing to the period of industrial depression through which we are passing, the demand is at the present largely dormant.

At such times it is not inopportune to consider the possibility of new types of engine, and bearing in mind the important work done by motor boats during the war, and the extended use of such craft in coastal service and in the fishing industry, we cannot doubt the success of a really first class marine motor embodying in a manner as yet unrealised the essential qualities of simplicity and reliability, and produced at reasonable cost. The latter factor would undoubtedly be favourably influenced by the standardising of marine motor fittings and accessories which, we understand, are difficult to obtain in quality suitable for all-weather service at sea. It is satisfactory to learn that some progress, if small, has now been made in the standardisation of marine motor parts. The Marine Committee, appointed by the Society of Motor Manufacturers and Traders, Limited, has recently submitted a report to the British Engineering Standards Association, concerning the sizes of propeller shaft couplings up to 6in. in diameter along with the necessary keyways and fastenings, and the question of shaft tapers will shortly occupy the attention of the committee. Although at the moment, makers may be reluctant to scrap existing patterns and drawings so as to conform to new standards, the work of the committee should be of considerable value to this section of the engineering industry.

"Simple" Carbon Steels.

THERE is, in a great many quarters, a feeling that carbon steels, as distinct from "alloy" or "special" steels are very simple and safe to handle, that they are free from complications of special heat treatment and can be used in the ordinary way without special care or knowledge. This feeling as to the more or less "fool-proof" character of the straight carbon steels weighs, in many cases, quite as much as the question of cost in favour of their adoption, so that there is a considerable number of uses for which special alloy steels could really be employed to considerable advantage, for which the plain carbon steel is preferred. Now, it is not to be denied that in order to yield their true and full value, alloy steels necessarily require the application of correct heat treatment. But a good deal more is made of the difficulty of such treatment than facts can really justify, though the necessity for a certain amount of care and skill cannot be denied. On the other hand, it must be borne in mind that the standard of re-

quired properties set for alloy steels is often extremely high, and departure from this high standard results from inadequate heat treatment.

The point of view we wish to emphasise here, however, is not so much the intrinsic merit of alloy steels for special purposes as the fact that it is too often forgotten that "simple" carbon steels are also extremely sensitive to heat treatment. If they are so handled as to yield the best possible results it will be found that, for many purposes, they meet even stringent requirements extremely well. But the great majority of users of these steels really expect very little of them. The working stresses to which they are submitted are kept down at the cost of increased weight and bulk, and in that way the steels are regarded as "good enough" without any special treatment or—what is, unfortunately, quite common—after fairly severe maltreatment. It is frequently forgotten that a saving in weight often means a proportionate saving in cost of material, and in many cases a disproportionately greater saving, in that it lessens the stresses which come upon other members of a structure or machine, and may thus indirectly allow of a saving of much greater weight. What we would urge, therefore, is a more rational and efficient use of the "simple" steels. If it is borne in mind that they also respond to a considerable extent to such processes as normalising and even to hardening and tempering, very great advantages can be secured. On the other hand, overheating or unduly hot finishing in the rolls or in the forge, or low temperature annealing, particularly if locally applied, may reduce the structural value of a carbon steel to rather less than half of what it should be. Yet, as we have said, positive ill-treatment is not uncommon, while carefully conducted correct treatment is rarely used. We may take, as an example, steel boiler plates. It is true that little trouble is experienced with boilers so far as the strength of the steel plates is concerned, although occasional cases of serious cracking are encountered. In a great many cases, of course, the boiler plate is turned out by the maker in a reasonably good condition so far as heat treatment is concerned; without special treatment, the rolling process is so conducted that it leaves the steel with a fairly satisfactory internal structure, and if it is not subsequently injured all is well. But when plates have to be flanged or otherwise worked, and sometimes in other cases, the steel is subsequently subjected to some kind of heat treatment which is extremely injurious. As a rule, this treatment takes the form of heating to quite a moderate temperature, probably just below the critical range of the steel. At best, such heating leads to a change in the internal structure of the steel which leaves it unduly soft and with a very low elastic limit. At times, however, the effect is local and much more severe. Parts of the plate undergo re-crystallisation in a way which brings about not only a harmful separation of the carbide from the iron crystals, but leaves the latter unduly coarse. Since this kind of "annealing" is sometimes done by the crude, if simple, process of lighting a fire under the plate, irregular and unsatisfactory results are not to be wondered at. The "factor of safety" serves in most cases to cover even this sort of mal-treatment, but if our demands upon mild steel were set higher, as they very well might be, in view of the properties it can be made to yield, it would soon be discovered how very much steel of the "simplest" kind can be thus damaged.

The example, we have chosen, covers one of the most important uses of very mild steel, since it is this class of material which is wrongly regarded as most completely "fool proof." With the harder steels, such as are used for tires and springs, matters are much worse and serious troubles are not so rare. The tempering of laminated springs without the use of pyrometers is still widely practised, while important forgings are frequently left without any special heat treatment whatever. All this results in the use of heavier parts in order to provide a factor of safety adequate to cover the irregularities of manufacture. What it really covers is merely the unwillingness or the inability of the manufacturer, on the one hand, to make use of available metallurgical knowledge for the improvement of his materials, and the failure of the engineer to appreciate what he might very well demand of the materials he employs. At the present time, in fact, the carbon steels are regarded as "simple" and "fool proof" merely because we are content to use them in a crude and often inefficient manner. The stress of competition, and the scientific utilisation of materials in other countries are bound to make themselves felt in this as in other fields, and it is to be hoped that, while by no means neglecting the alloy steels, our steel makers and engineers will devote their attention to the more efficient treatment and utilisation of the cheaper carbon steels which, used at their best, do not fall so far behind the special steels as is sometimes supposed.

Locomotive Power.

By E. C. POULTNEY, O.B.E.

The following article describes a method of quickly obtaining the probable draw-bar pull of any steam locomotive of conventional design at all speeds usual in practice.

When estimating the power of a locomotive at a given speed certain principal factors have to be taken into consideration; they are the maximum tractive effort, the steaming power of the boiler, and the combined effect of the boiler capacity and speed on the running tractive effort, and also the resistance of the locomotive.

It is proposed to discuss shortly these factors in the order mentioned.

The Maximum Tractive Effort or Rated Tractive Force.

This is calculated by the usual method, which for two-cylinder engines is as follows:—

$$\text{R.T.F.} = \frac{d^2 \times S \times 0.85\,P}{D} \quad . \quad . \quad (1)$$

d = cylinder diameter in inches.
S = stroke in inches.
D = diameter of drivers in inches.
P = boiler steam pressure.

The mean effective pressure is assumed to be equal to 85 per cent. of the boiler working pressure. The choice of the factor 0.85 for estimating the mean pressure acting on the pistons is based on the assumption that when running in full gear at low speed the cut-off is such that the actual mean indicated pressure is equal to 92 per cent. of the boiler pressure, and that machine friction absorbs 8 per cent. of the indicated power ($0.92 \times 0.92 = 84.5$), say, 85. The rated tractive force thus obtained gives, of course, the tractive force at the rim of the driving wheels, and in that way fulfils two purposes: it gives the tractive force available and also enables the adhesive factor to be obtained. If the full gear cut-off is very short the indicated mean pressure would fall below 92 per cent. of the maximum pressure, and the mean pressure might only amount to, say, 80 per cent.; in such case the value of P in the formula would be 0.74 P ($0.80 \times 0.92 = 73.5$), say, 74 per cent. However, with the rates of cut-off usual in full gear working the indicated mean pressure at slow speeds will usually be about 90 per cent. of the maximum; hence 0.85 P gives a sufficiently near estimate when calculating the R.T.F. at the rim of the driving wheels.

Boiler Steaming Capacity.

For practical purposes in computing locomotive power the boiler steaming capacity may be taken as being directly proportional to the total heating surface. In making this statement it is as well to point out at the same time that boilers differently proportioned will give different results. The ratio existing between the grate area and heating surface will affect the evaporative performance per square foot of heating surface for any given rate of firing per square foot of grate per hour, for the reason that the larger the grate in proportion to the heating surface the larger will be the amount of coal fired per square foot of heating surface, and consequently proportionately more gas will pass over each square foot of heating surface per unit of time.

On the other hand, increasing the coal fired per square foot of heating surface adversely affects the economic performance of the boiler by lowering the amount of water evaporated per pound of fuel fired. The point to be aimed at in boiler designing is in the first place to get the highest rate of evaporation possible, and secondly, to obtain the evaporation with a reasonable evaporation per pound of coal used. The importance of this lies in the fact that the greater the rate of evaporation the smaller will be the boiler for a given power output, and hence the lighter the engine per unit of power developed. In the calculations for obtaining the power of locomotives which follow an actual evaporation of 12 lb. of water per square foot of heating surface per hour is assumed as usually with reasonably good fuel; this rate should permit of between 7 lb. and 8 lb. of water being evaporated per pound of coal fired.

Combined Effect of Steam Production and Consumption on the Power Developed.

In estimating the tractive force at speed it is necessary to consider the steaming capacity of the boiler and the steam consumption of the engines per horse-power developed. The speed in miles per hour has no direct effect on the evaporative performance of the boiler, but it has, through piston speed, an effect on the engines in two ways, because an increase in piston speed decreases the steam consumption per horse-power, and, other things being equal, the horse-power increases directly as the piston speed.

From the above it will be evident that the heating surface necessary to furnish any given power at the cylinders will vary with the piston speed and, through it, with the speed in miles per hour.

In order to obtain an approximately correct estimate of the amount of heating surface necessary per unit of horse-power at the cylinders, the writer adopted the following method:—The water rate per indicated horse-power-hour from actual tests was plotted against piston speeds in feet per minute, and the stroke of the pistons and driving wheel diameters being known, the water rates were also plotted against miles per hour.

Available information as to the indicated horse-powers obtained on actual road tests at various speeds and certain test plant results were at the same time examined, and the indicated powers obtained per square foot of actual and, in the case of superheated engines, equivalent heating surface were calculated.

The results of this investigation are shown tabulated in Table I, which gives from actual tests the

Table I.—*Heating Surface per Indicated Horse-power and Speed, Miles per Hour.*

M.P.H.	1	2	3	4	5	6	7
15	—	—	—	—	—	—	2.62
20	—	—	—	2.36	3.1	—	2.39
21	—	—	—	—	—	2.1	—
30	—	3.5	3.5	—	—	—	2.13
37	3.09	2.48	3.16	1.90	—	—	—
40	—	—	—	—	—	—	2.04
42	—	—	—	1.93	—	—	—
46	—	2.0	2.79	—	2.3	—	—
50	—	—	—	—	—	1.84	1.96
51	—	—	—	—	1.93	—	—
54	—	—	—	—	1.76	—	—
55	—	1.97	2.47	1.90	—	—	—
57	—	—	—	—	—	1.82	—
60	1.90	—	—	1.93	1.83	1.67	1.91
62	—	—	—	—	1.71	—	—
63	—	—	—	1.84	—	—	—
65	—	1.78	2.14	—	—	—	—
68	1.87	—	—	—	—	—	—
69	2.03	—	—	—	—	—	—
70	1.73	—	—	—	—	—	1.88
71	1.94	—	—	—	—	—	—
74	—	1.70	2.08	—	1.72	1.84	—
78	1.65	—	—	—	—	—	—
80	—	—	—	—	—	—	1.86
83	—	1.70	1.99	—	—	—	—

heating surface required per indicated horse-power at various speeds in miles per hour. The results in columns 1, 4, 5 and 6 are derived from road tests, and those in columns 2 and 3 are test plant results, whilst column 7 is taken from Fig. 1 and Table II. and represents the figures for passenger engines. For column 1 the drivers are 78in. with a piston stroke of 24in., and for columns 2 and 3 the drivers are 80in. diameter, with a piston stroke of 26in.; but the other columns are for engines having 81in. drivers and a piston stroke of 26in. The results shown were plotted and a curve drawn which seemed to represent fairly an average for the entire plot. The rather high values for the heating surfaces per indicated horse-

Table II.—*Heating Surface and Water Rate per Horse-power and Speed, Miles per Hour.*

Speed M.P.H.	H.S. per I.H.P.	Water per I.H.P. hour.	H.S. per H.P. at drivers.
Driving wheels 73in. to 84in. diameter, passenger engines.			
10	2.99	35.9	3.25
15	2.62	31.4	2.85
20	2.37	28.5	2.57
30	2.13	25.6	2.32
40	2.04	24.5	2.21
50	1.96	23.5	2.13
60	1.91	23.0	2.08
70	1.88	22.6	2.04
80	1.86	22.3	2.02
Driving wheels 54in. to 72in. diameter, goods engines.			
10	2.85	34.2	3.10
15	2.48	29.8	2.70
20	2.25	27.0	2.44
30	2.04	24.5	2.21
40	1.96	23.5	2.1
50	1.91	23.0	2.08
60	1.88	22.6	2.04

power given for the engines used for columns 2 and 3 were disregarded, for the reason that the cut-off at the low speed of 30 miles per hour was somewhat shorter than would be expected in practice, and hence the indicated powers were rather low. The average curve drawn served to show the form that a heating surface horse-power curve would take, and, as would be expected, it followed on general lines those obtained by plotted water rates and piston speeds.

Next, for passenger engines, a curve for heating surface per indicated horse-power at speeds from 10 to 80 miles per hour was drawn for wheels 78in. diameter and a piston stroke of 26in. The water rates were made to correspond closely with those taken from actual tests, and the amount of heating surface allowed made to agree with an evaporation of 12 lb. of water per hour. The water rates given by the new curve were, as a check, plotted in the graph made from actual test against miles per hour and found to agree

with very reasonable accuracy. For goods locomotives another curve was drawn which gives closely the same amount of heating surface per indicated horse-power-hour at approximately equal piston speeds, the diameter of the driving wheels being 63in. and the stroke of the pistons 26in. The heating surface horse-power curves are both shown in Fig. 1, the dotted lines giving the heating surface per indicated horse-power and the full lines the heating surface per horse-power at the rim of the drivers. This line gives values 8 per cent. more for the heating surface required per horse-power in order to make allowance for machine friction.

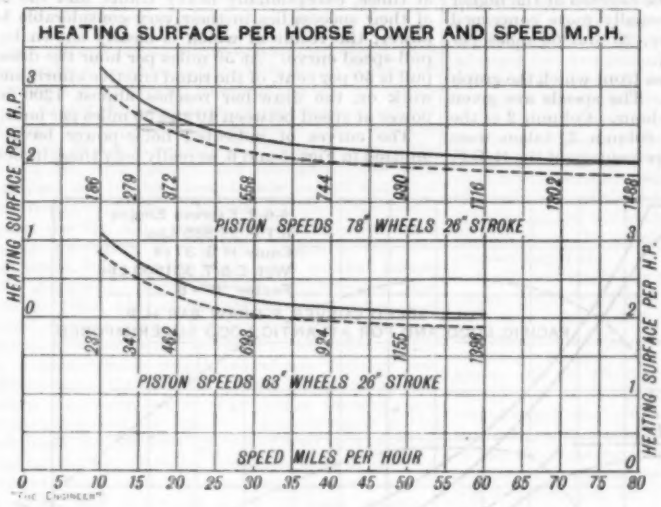


FIG. 1

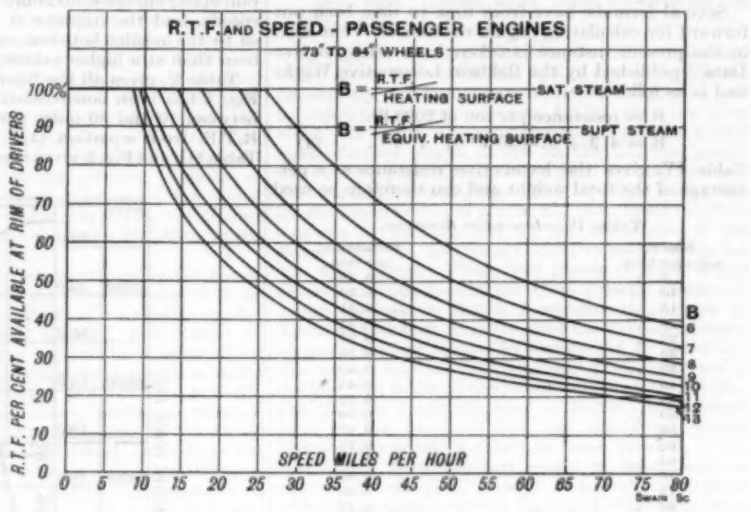

R.T.F. AND SPEED - PASSENGER ENGINES
73" TO 84" WHEELS
B = R.T.F. / HEATING SURFACE SAT. STEAM
B = R.T.F. / EQUIV. HEATING SURFACE SUPT STEAM
R.T.F. PER CENT AVAILABLE AT RIM OF DRIVERS
100% 90 80 70 60 50 40 30 20 10 0
B 6 7 8 9 10 11 12 13
SPEED MILES PER HOUR
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
SWAIN Sc

FIG. 2

speeds in miles per hour each consume equal quantities of steam per horse-power, and for these engines the respective values of B are 8 and 10 respectively, then the engine having a boiler factor of 10 demands 25 per cent. more power per unit of heating surface than the engine having proportionately the larger boiler, as shown by the factor 8. From this deduction it follows, if in each case the evaporative value per square foot of heating of the boilers is equal, or, in other words, the boiler power is proportional to the heating surface, that at equal speeds the engine having a boiler factor of 10 will develop a smaller proportion of its R.T.F. by 25 per cent. than the engine having the boiler factor 8. Put in another way, if two engines each make the same speed in miles per hour, the percentage of its rated tractive force that each can maintain is inversely proportional to the value of B, and if each engine develops the same percentage of its rated tractive power, then their respective speeds will be inversely proportional to the value of B.

The curves shown in Figs. 2 and 3 give the relation between the rated tractive force at the rim of the driving wheels and speed in miles per hour, and indicate how an increase in heating surface relative to the maximum rated tractive force from equation (1) increases the percentage of the rated tractive force available at all speeds. The curves have been calculated from equation (2), the heating surface per horse-power at the rim of drivers having the values shown in the last column of Table II.

Fig. 2 gives the tractive force curves for passenger engines, each curve giving this information for different boiler factors B, the values of which shown are those most used for express locomotives.

In like manner Fig. 3 gives the percentage of the rated tractive force obtainable at speeds from 10 to 60 miles per hour for goods and mixed traffic engines. The curves have been drawn giving that information for seven different values of the boiler factor "B," those given being most usually found for such engines. The curves have not been extended for speeds above 60 miles per hour because engines in such services do not generally run at higher speeds. For goods locomotive operation draw-bar pull is a greater factor than speed, and engines in such service do not as a rule run at higher speeds than 30 miles per hour, at which speed the percentage of the rated tractive power available at the rim of the drivers varies from about 32 to 48 per cent. according to the size of the boiler relative to the R.T.F.

TABLE III.—*Proportion of Rated Tractive Force (R.T.F.) at Rim of Drivers per Cent. for Different Values of the Boiler Factor "B."*

Passenger engines, 73in. to 74in. wheels.

Speed, miles per hr.	Values of boiler factor "B."							
	6	7	8	9	10	11	12	13
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
10	100	100	100	100	100	100	96.0	88.5
15	100	100	100	97.2	87.8	79.7	73.0	67.1
20	100	100	91.4	81.0	72.8	66.4	60.6	56.0
30	89.7	78.0	67.3	59.7	53.8	48.9	45.0	41.2
40	70.7	60.5	53.0	47.0	42.5	38.6	34.7	32.6
50	58.6	50.3	44.0	39.0	35.2	32.0	29.3	27.1
60	50.2	43.0	37.7	33.4	30.2	27.4	25.2	23.2
70	43.6	37.4	32.7	29.2	26.3	23.8	21.9	20.2
80	38.6	33.1	29.0	25.8	23.2	21.1	19.4	17.8

Goods engines, 54in. to 72in. wheels.

Speed, miles per hour.	Values of boiler factor "B."						
	12	13	14	15	16	17	18
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
10	100.0	93.0	86.2	80.6	75.5	71.0	67.2
15	77.0	71.0	66.0	61.7	57.7	54.5	51.5
20	64.0	58.7	54.7	51.2	48.0	45.2	42.7
30	47.2	43.2	40.4	37.7	35.4	33.2	31.4
40	36.7	33.6	31.3	29.4	27.5	25.9	24.5
50	30.2	27.8	25.9	24.2	22.7	21.3	20.1
60	25.5	23.5	21.9	20.4	19.1	18.0	17.0

For convenience Table III. has been prepared. It gives the proportion of the R.T.F. per cent. for different values of the boiler factor "B" for both passenger and goods locomotives. The values given are those used in plotting the curves shown in Figs. 2 and 3. Knowing the maximum rated tractive force at the rim of the drivers and the relation between the R.T.F. and the total actual or equivalent heating surface, the rated tractive force at the rim of the drivers for any given speed can be readily found by multiplying the maximum R.T.F. by the percentage value given for the particular speed. The actual pull

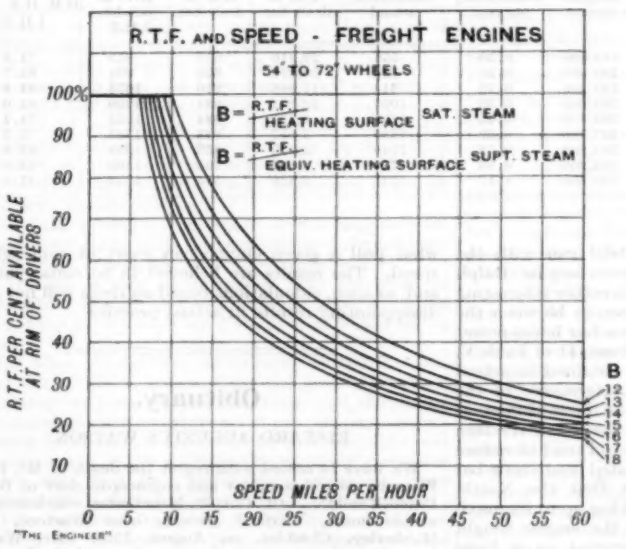

R.T.F. AND SPEED - FREIGHT ENGINES
54" TO 72" WHEELS
B = R.T.F. / HEATING SURFACE SAT. STEAM
B = R.T.F. / EQUIV. HEATING SURFACE SUPT. STEAM
R.T.F. PER CENT AVAILABLE AT RIM OF DRIVERS
100% 90 80 70 60 50 40 30 20 10
B 12 13 14 15 16 17 18
SPEED MILES PER HOUR
0 5 10 15 20 25 30 35 40 45 50 55 60
"THE ENGINEER"

FIG. 3

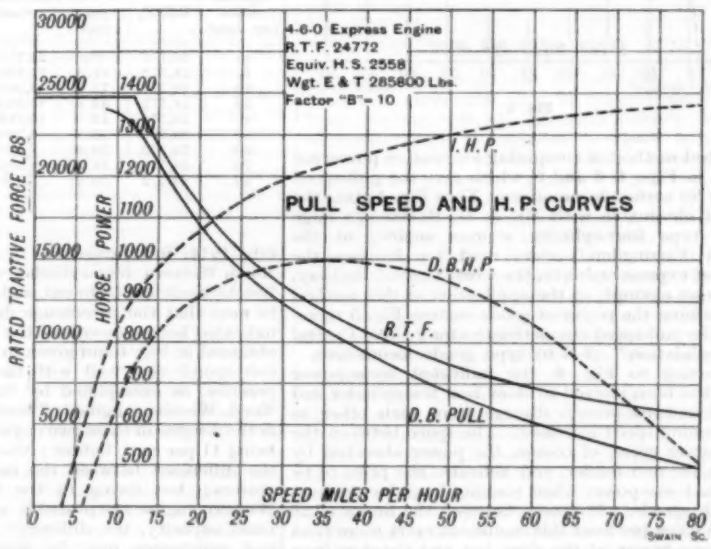

4-6-0 Express Engine
R.T.F. 24772
Equiv. H.S. 2558
Wgt. E & T 285800 Lbs.
Factor "B" = 10
RATED TRACTIVE FORCE LBS
HORSE POWER
30000 25000 20000 15000 10000 5000
1400 1300 1200 1100 1000 900 800 700 600 500
I.H.P.
PULL SPEED AND H.P. CURVES
D.B.H.P.
R.T.F.
D.B. PULL
SPEED MILES PER HOUR
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
SWAIN Sc

FIG. 4

HEATING SURFACE, INDICATED HORSE-POWER AND TRACTIVE FORCE.

Having established a means of computing the horse-power at the cylinders or the rim of the drivers per square foot of heating surface for engines having either large or small wheels, the rated tractive force or the indicated tractive force can be obtained for all speeds from the following formula :—

$$\text{H.P.} = \frac{\text{T} \times \text{V}}{375} \quad . \; . \; . \quad (2)$$

or

$$\text{I.H.P.} = \frac{\text{T 1} \times \text{V}}{375} \quad . \; . \; . \quad (3)$$

I.H.P. = indicated horse-power.
T 1 = indicated tractive force.
H.P. = horse-power at drivers.
T = R.T.F.
V = speed, miles per hour.

The boiler factor "B" obtained by dividing the maximum tractive force from equation (1) by the heating surface gives the amount in pounds of tractive force (R.T.F.) which must be furnished by each square foot of heating surface. If two engines running

in pounds at the draw-bar is the value thus obtained less the resistance of the locomotive.

LOCOMOTIVE RESISTANCE.

Several formulæ have from time to time been put forward for calculating engine resistance. That used in the present instance is taken from "Locomotive Data" published by the Baldwin Locomotive Works and is as follows:—

$$R = \text{resistance per ton of 2000 lb.}$$

$$R = 4.3 + 0.0030\ V^2 \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Table IV. gives the locomotive resistance as a percentage of the total weight and can therefore be used

TABLE IV.—*Locomotive Resistance.*

Speed, miles per hour.	Resistance, per cent.
5	0.38
10	0.30
15	0.31
20	0.32
25	0.34
30	0.36
35	0.40
40	0.45
45	0.52
50	0.59
55	0.67
60	0.75
65	0.85
70	0.95
75	1.06
80	1.17

quite readily if the weight is given either in tons (2240 lb. or 2000 lb.) or in pounds. The latter will, as a rule, be the most convenient, because the rated tractive force will almost always be given in pounds. The values given in the table cover only rolling and head air resistances. Machine friction has been allowed for, as already explained.

Results obtained by application of the above-

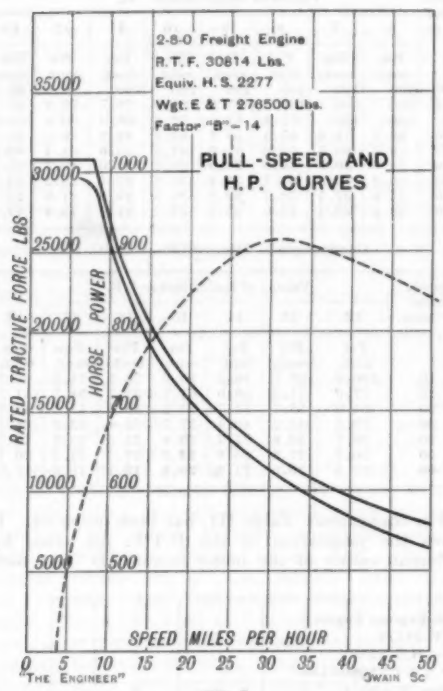


FIG. 5

described method of computing locomotive power are shown in Figs. 4, 5 and 6, which give the pull-speed curves for certain locomotives. Thus Fig. 4 gives the powers obtainable with Mr. J. G. Robinson's large 4–6–0 type four-cylinder express engines of the "Lord Farringdon" class used for hauling the heaviest express trains on the Great Central Railway, and as an example of the application of this method of obtaining the power of goods engines Fig. 5 represents the pull-speed characteristics for a Great Central "Consolidation" (2–8–0) type goods locomotive.

Referring to Fig. 4, the indicated horse-power curve has been plotted to show how the cylinder and draw-bar horse-powers diverge from each other as the running speed increases. The space between the two curves gives, of course, the power absorbed by the engine and tender, and indicates the price to be paid in horse-power when running large locomotives at high speeds. At speeds between the limits of 20 and 55 miles per hour this engine can exert more than 900 horse-power at the draw-bar and develop from about 1080 to 1320 indicated horse-power.

By using the expression "equivalent heating surface" (obtained by adding to the evaporative surface a value equal to the superheater surface multiplied by 1.5) for calculating the power of superheated locomotives, it is, of course, assumed that the engines are supplied with saturated steam. The indicated horse-power curve should therefore fall somewhat after a piston speed of from 1000ft. to 1200ft. per minute has been reached, say, for express engines 60 miles per hour. On the other hand, as nearly all locomotives are now superheated it seems reasonable to run the indicated horse-power curves as shown, because with superheated steam the indicated horse-power keeps up at the higher speeds. In any case the pull-speed curves would only be affected at the higher speeds, and the inquirer is usually more concerned as to the results between, say, 20 and 60 miles per hour than at a higher velocity.

Table V. gives all the figures from which the graph Fig. 4 has been constructed. The speeds are given between 10 and 80 miles per hour. Column 2 is the R.T.F. from equation (1); column 3, taken from Table III. and Fig. 2, gives the percentage of the R.T.F.

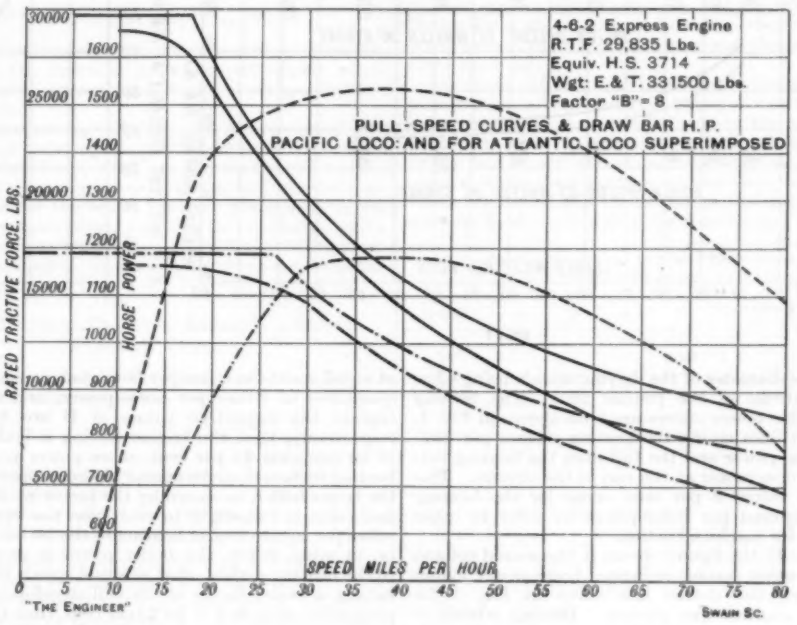


FIG. 6

obtainable with the factor B equal to 10, and column 4 is columns 2 and 3 multiplied together. The full loaded weight of the engine and tender is entered in column 5 expressed in pounds, and the locomotive resistance from Table IV. is shown in column 6. Column 5 multiplied by column 6 equals column 7, which gives the resistance of the locomotive in pounds. Column 4 less column 7 gives the pull at the draw-bar shown in column 8. The draw-bar horse-power in column 9 is calculated from equation (2), using the values in 8, and the indicated horse-power entered in column 10 is found by dividing the heating surface successively by the values given for passenger engines in the heating surface per indicated horse-power column of Table II.

If reference is made to THE ENGINEER of February 6th, 1914, full particulars of a trial run with the North-Western four-cylinder express engine Ralph Brocklebank will be found, and it is rather interesting to note that the percentage differences between the indicated horse-power and the draw-bar horse-power obtained in Fig. 4 and given in column 11 of Table V. correspond very well with those obtained in actual practice, as exemplified by the performance of the North-Western engine. There is a little difference in the weights of these two engines, the North-Western being 11 per cent. lighter; this would tend to reduce the difference between the indicated and draw-bar powers; but owing to the fact that the North-Western engine was probably working up to its maximum capacity, the difference in the engine weight and resistances may be counteracted to a large extent. Fig. 6 has been prepared to illustrate the probable power of Mr. H. N. Gresley's large new "Pacific" type express locomotives built for service on the Great Northern. The curves show that between 30 and 50 miles per hour 1500 horse-power can be furnished at the draw-bar, between which limits the actual pull is from 19,000 lb. to 11,000 lb. Superimposed and shown in chain-dotted lines similar information is given for the Great Northern standard wide fire-box Atlantics, and a comparison of the curves gives at once an idea of the great increment in power obtained by the introduction of the Pacific locomotives.

Although of relatively small nominal tractive power, the Atlantic engines have done splendid work with, at times, exceptionally heavy trains, and the secret of their success lies in their very considerable boiler power, the result of which is clearly shown by the pull-speed curve. At 50 miles per hour the draw-bar pull is 50 per cent. of the rated tractive effort, and the work on the draw-bar reaches almost 1200 horse-power at speed between 40 and 50 miles per hour.

The curves of indicated horse-power have been omitted in Figs. 5 and 6, as really only those indicating the actual work on the draw-bar are of practical interest to the designer and superintendent of motive power.

The pull-speed curves give information as to the actual pull that the engine can exert, and the draw-bar horse-power curves, being a product of the pull and speed, give information as to the speeds at which the engine will give the greatest return in ton-miles per hour.

In conclusion, the writer may say that, in the first place, the method of computing the tractive force of locomotives described was worked out in the nature of an experiment to satisfy a personal interest. The results, however, seem to be generally so nearly what might be expected that they are offered as a means of readily answering the question so often asked as to what pull a given engine can exert at some given speed. The results are believed to be conservative, and, as such, calculations based on them will not give disappointing results in actual practice.

TABLE V.

1	2	3	4	5	6	7	8	9	10	11
Speed, miles per hour.	R.T.F.	R.T.F., per cent.	R.T.F., actual.	Weight, extreme.	Resistance, per cent.	Resistance, actual.	Pull at draw-bar.	H.P. at draw-bar.	H.P. at cylinders, I.H.P.	D.B. H.P. × 100 / I.H.P.
10	24,772	× 100 =	24,772	285,800	0.30	856	23,916	637	853	74.5
15	24,772	87.8	21,700	285,800	0.31	886	20,824	836	974	85.7
20	24,772	72.8	18,000	285,800	0.32	914	17,086	910	1078	84.4
30	24,772	53.8	13,320	285,800	0.36	1027	12,293	984	1200	82.0
40	24,772	42.5	10,510	285,800	0.45	1283	9,227	984	1252	78.4
50	24,772	35.2	8,700	285,800	0.59	1683	7,017	943	1303	72.2
60	24,772	30.2	7,470	285,800	0.75	2140	5,330	853	1338	63.8
70	24,772	26.3	6,500	285,800	0.95	2710	3,890	725	1360	53.3
80	24,772	23.2	5,750	285,800	1.17	3340	2,410	515	1373	37.5

Obituary.

EDWARD AUGUSTUS WATSON.

WE have to record with regret the death of Mr. E. A. Watson, general manager and engineer-in-chief of Beyer, Peacock and Co., Ltd., Gorton, Manchester, which occurred at his home, Warford House, Great Warford, near Mobberley, Cheshire, on August 25th. Mr. Watson began his railway career in America, first with the American Locomotive Company, of Schenectady, and later with the Pennsylvania Railway at Altoona. Returning to England, he joined the Great Western Railway Company, being engaged at its Swindon works as assistant works manager; thence he went to Ireland to take up the position of works manager at the Great Southern and Western Railway Company's works at Inchicore. He subsequently became chief mechanical engineer to that company, which position he relinquished in November, 1921, on accepting the post of general manager and engineer-in-chief of Messrs. Beyer, Peacock. He was a member of the Institution of Mechanical Engineers.

The Railway Gauge Problem in Australia.*

UNIFICATION OF GAUGE.

WHEN railway construction was started about 1854—practically simultaneously in New South Wales and Victoria—it was intended to adopt the 5ft. 3in. gauge in both States, but a change of professional adviser at Sydney brought about a change of view, and the New South Wales Government decided to adopt the standard 4ft. 8½in. gauge, and this gauge has been maintained up to the present date on all the New South Wales railways. Victoria, on the other hand, adopted the 5ft. 3in. gauge from the first, and has, with the exception of a trifling length of 2ft. 6in. gauge track, built all her State lines on that gauge. South Australia, when railway construction was begun in 1855, also chose the 5ft. 3in. gauge and adhered to this gauge for some years; later on, however, in order to reduce the first cost of construction, a considerable length of railway mileage was constructed on the 3ft. 6in. gauge. Queensland and Western Australia, when they began railway construction, selected the 3ft. 6in. gauge because of the possibilities the narrower gauge offered in reduction of capital outlay. Briefly, therefore, four of the five mainland States have uniform gauges in their respective areas, and there are three of these gauges—5ft. 3in., 4ft. 8½in., and 3ft. 6in.—while the fifth State has two gauges, 5ft. 3in. and 3ft. 6in. The Commonwealth, when it was decided to build the East-West transcontinental line, chose the 4ft. 8½in. gauge.

As soon as the four capitals—Adelaide, Melbourne, Sydney, and Brisbane—were connected by railways the delays and additional working expenses inevitable with any change of gauge began to be realised, and as early as 1888 Mr. Eddy, Chief Commissioner for the New South Wales Railways, drew attention to the matter and urged that steps should be taken to secure unification of gauges. In 1897 a Premiers' conference, held in Adelaide, instructed the various State railway commissioners to report on the whole question of unification of gauges. A conference was therefore held in Melbourne in August, 1897, and this conference unanimously agreed to recommend that 4ft. 8½in. be adopted as the standard Australian gauge; the decision was based on the fact that it would be cheaper to convert the 5ft. 3in. to 4ft. 8½in., and that 3ft. 6in. was too narrow a gauge for main line traffic. It was estimated that the cost of unification would be about £23,600,000. None of the States took any steps to carry out the recommendations of the conference.

In 1903 it became necessary to decide upon the gauge which should be adopted for the East-West transcontinental line to connect Western Australia with the eastern provinces, the length of the line being about 1063 miles. A conference of the Engineers-in-Chief of the five States unanimously recommended that 4ft. 8½in. should be the gauge of this important line, and eventually the line was built on this gauge. This decision was later on confirmed at a meeting in 1911 of the Railway War Council, attended also by the Chief Commissioners of the various State railways. In 1911, Mr. H. Deane, the Chief Engineer of Railways to the Commonwealth, was, as a result of a memorandum by Mr. Hales, of Launceston, instructed to reconsider the whole question of the standard gauge. He advised that the decision to adopt the 4ft. 8½in. gauge should be adhered to; he was opposed to the adoption of any narrower gauge than that, and he pointed out that a 5-chain curve could be used even on a 4ft. 8½in. gauge track under certain conditions, and that such lines had been constructed not only in Australia but in other countries. With regard to the method of conversion, Mr. Deane advocated the third-rail method, and he gave in his report a brief account of the various methods which had been adopted in other countries where unification of gauges had been carried out.

In 1913 a further conference of the Engineers-in-Chief was held, and this conference adopted two resolutions of considerable importance:—

(1) That it was advantageous that the work of unification should be undertaken at once, since the longer the work was delayed the greater would be the cost.

(2) That the relative advantages of the 5ft. 3in. and the 4ft. 8½in. gauges from the point of view of efficiency and economy of working, and discarding the question of interest on cost of conversion, approximately balanced one another, and that, since the cost of conversion of the wider to the narrower gauge was much less than for the converse operation, they recommended the adoption of the 4ft. 8½in. gauge.

This conference estimated that the cost of converting all the railway lines of Australia to the 4ft. 8½in. gauge would be £37,164,000, but, if it were decided merely to unify the main line routes connecting the various capitals, the cost would be £12,142,000. Of this latter sum the new lines which would be required would account for £4,847,000, and the conversion of the existing 5ft. 3in. lines (all the Victorian but only some of the South Australian) would cost £7,295,000.

The decision of the Commonwealth Government to adopt the 4ft. 8½in. gauge for the East-West transcontinental line, and the construction of that line on that gauge, ought to have settled definitely the choice of the standard railway gauge for Australia, but the question was reopened, and a Royal Commission was appointed on February 8th, 1921, to report on the whole question of the standard gauge which should be adopted for Australian railways, and to submit estimates of the cost of conversion and recommendations as to how the work should be carried out. This Royal Commission unanimously recommended that the previous decisions as to the adoption of the 4ft. 8½in. gauge should be adhered to; they were of opinion that no important gain in the carrying capacity of the railways would be secured by using the wider 5ft. 3in. gauge, while the reduction in the cost of conversion would be considerable if the 4ft. 8½in. gauge were adhered to.

Much confusion has arisen in discussing the gauge question by the failure on the part of many of those who took part in the controversy to appreciate the difference between "track gauge" and "load or structure gauge." At the present time locomotives are in use on 4ft. 8½in. gauge lines giving a static pressure of 35,000 lb. between the rail head and the wheel tread, and such a pressure produces probably the maximum permissible deformation in the metal of the rail head and the wheel tread, hence it is the quality of the metal used in the rails and in the tires which determines ultimately the carrying capacity of the 4ft. 8½in. or any other gauge. On the other hand, the structure gauge determines the density the load must have in order to load the wheels to their maximum capacity; and it is, therefore, to structural gauge changes that attention should in the first place be given. The Australian 1905 uniform structure gauge, when outside cylinder locomotives are used, permits the use of bigger diameter engine cylinders on a 4ft. 8½in. gauge track than on a 5ft. 3in. gauge line. On the other hand, the 5ft. 3in. gauge permits a higher centre of gravity with the same stability and ease of riding, but this higher centre of gravity is unobtainable with the usual goods traffic on Australian lines. Undoubtedly it would cost less to change from the wider to the narrower gauge than to carry out the converse operation, since in the former the same sleepers can be used, and no changes in banks, cuttings, and ballast are required, and in the conversion of the rolling stock the change from the wider to the narrower means shortening the axles of the rolling-stock wheels, a simple matter, while to carry out the reverse operation of lengthening these axles would be practically impossible. At the present time there are about 60,000,000 sleepers on the Australian railway lines, of which about half are on the 3ft. 6in. gauge lines. The average life of a sleeper in Australia is about twenty years, and, therefore, the annual renewals run to about 3,000,000 sleepers, but, owing to the results of war conditions, the annual renewals at the present time are nearly 5,000,000. Some 75 per cent. of the 3ft. 6in. sleepers now in use are 7ft. long, and such a sleeper could be used with a 4ft. 8½in. gauge if for each rail four new 8ft. long sleepers were introduced along with old 7ft. sleepers, one at each end and the other two equally spaced in between, provided that only 60 lb. rails were used and that the traffic was neither heavy nor fast. If such an arrangement were adopted there would be a saving of something like 12,500,000 sleepers during the process of conversion of the gauges.

The Commission considered very carefully the various proposals which had been made to obviate the need of the conversion of the running track, such as, for example, the third-rail method and the many mechanical devices which had been suggested for allowing the same rolling stock to be run over different gauges, and unanimously turned them all down; in fact, a special board of experts had been appointed in 1918 to examine and report upon a number of these mechanical devices and suggestions, and had been unable to report favourably on any of them. All such devices were merely in the nature of temporary plans for postponing the ultimate conversion to a uniform gauge; they therefore involved additional expenditure and an increase in the final total cost of conversion. The Commission recommended that the unification should be carried out gradually by shifting one of the two rails of the 5ft. 3in. gauge inwards, and shifting both the rails in the case of the 3ft. 6in. gauge outwards, the work to be done in stages and temporary change stations to be arranged for, the traffic being diverted as far as necessary while the length of track between two change stations was being altered.

The Royal Commission estimated that the conversion of all lines to the 4ft. 8½in. gauge would involve a capital expenditure of about £57,200,000; this estimate made provision for the necessary transfer temporary stations as well as the actual work of conversion, but did not provide anything for the cost of transfer of goods and passengers during the transition period, or for interest on capital expenditure while the work was being carried out.

The Commission recommended the appointment of a director to carry out the whole work, who should be assisted by a competent professional staff. In forwarding their report to the Commonwealth Government the Chairman raised the important question as to whether the huge expenditure which would be required would be justified under existing conditions of the money market and the present high cost of all engineering works.

CHIEF WORKS REQUIRED TO GIVE A UNIFORM 4FT. 8½IN. GAUGE LINE FROM FREMANTLE TO BRISBANE.

As regards Western Australia, it will be necessary to lay a new line on the 4ft. 8½in. gauge alongside the present 3ft. 6in. gauge from Perth to Kalgoorlie, and to construct an entirely new bridge over the river Swan. In South Australia there is at present a very unsatisfactory length of line on the 3ft. 6in. gauge, with severe gradients and awkward curves, between Terowie and Port Augusta. This would be eliminated by the construction of a new 4ft. 8½in. line from Port Augusta to Lochiel, and by the conversion of the existing 5ft. 3in. line from Lochiel to Salisbury to the 4ft. 8½in. gauge. These two pieces of work would at once cut out two of the three present change-of-gauge stations in South Australia—viz., those at Adelaide and Port Augusta, and the Terowie change-of-gauge station would be transferred to Salisbury. The reduction in the existing heavy grades is shown by the fact that while on the present route on the 3ft. 6in. line there is a summit level of 2000ft., the summit level on the proposed new line would not exceed 400ft. This work, if taken in hand at once, would cost about £800,000, and would in itself, without any other changes, greatly improve the present railway facilities between East and West Australia. In converting the 5ft. 3in. line from Adelaide to Melbourne the most important work would be a new bridge over the river Murray, suitable for the heavier rolling stock. In Victoria the Commissioners suggested three alternative routes, but they pointed out that Route A would be very costly and difficult to work, and therefore it would be much more satisfactory, if the remaining 5ft. 3in. gauge lines in Victoria were not to be converted, to adopt Route B. There is no doubt, however, that the adoption of either Route A or Route B would prove extremely unsatisfactory as regards the working of the remaining railway systems of Victoria; it would be much better to decide to convert at once the whole of the 5ft. 3in. Victorian lines to 4ft. 8½in., carrying out the work in a series of stages.

Since all the New South Wales railways are on the 4ft. 8½in. gauge, the only works required in the State would be the completion of the coastal route northwards from West Maitland; much of the constructional work on this coastal route is already completed. When it is completed as far as Richmond Gap, and when a new 4ft. 8½in. gauge line is built southwards from Brisbane to join the New South Wales line at Richmond Gap, a greatly superior route will be provided between the capitals of Sydney and Brisbane. The present inland route has a maximum summit level of 4450ft., while the coastal route would not have a greater summit level than 800ft.

The report of the Royal Commission was considered at a Premiers' Conference held at Melbourne in November, 1921. Mr. Groom, the Federal Minister of Works and Railways, in view of the enormous cost for complete conversion, advocated that the work of providing the main line route connecting all the capitals by a 4ft. 8½in. high-standard line should be undertaken at once, and also the work of the conversion of all other Victorian and South Australian 5ft. 3in. gauge lines to 4ft. 8½in. The total cost of these two pieces of work would be about £21,000,000. The Premier of South Australia, however, raised serious objections, the principal one being the difficulties which would arise in the working of the local railway traffic owing to the 3ft. 6in. lines of that State being left unchanged, and he pointed out that his State Railway officials disagreed entirely with the estimates of the Commission in regard to the cost of the conversion of all the railway lines in South Australia to the standard gauge. They were of opinion that instead of the cost amounting to about £8,737,000, as estimated by the Commissioners, it would be more like £14,750,000, and, in addition to this heavy capital outlay, there would be a serious loss of revenue brought about by delays in operating the traffic during the process of conversion. He was of opinion, and his views were apparently supported by the Premier of Victoria, that the whole cost of conversion of the railways in Australia to a 4ft. 8½in. gauge would not be far short of £100,000,000 sterling, and he thought that it would be very much wiser to spend this huge sum of money on public works which would be more quickly reproductive.

The Premiers' Conference eventually accepted the decision of the Royal Commission with regard to the adoption of the 4ft. 8½in. gauge, but postponed decision as to when the work should be undertaken.

The Australian Prime Minister in March last, in a public speech, drew attention to the steadily increasing cost of the work of conversion, and to the considerably increased loss in working the existing State and Commonwealth railways. For the year ending June 30th, 1920, he stated that after paying interest on loans and all working expenses there was a total deficit of £1,744,000, and in 1921 this had risen to £3,946,000. He expressed the view that very important economies in working expenses would be brought about by unification of gauges.

In giving this summary of the history of the break-of-gauge problem in Australia I have endeavoured to

* From an address by Professor T. Hudson Beare, B.A., B.Sc. D.L., President of Section G, British Association.—Abridged.

arouse interest in this country on this question. A great scheme of railway work, which is to cost anything from £50,000,000 to £100,000,000, and which will involve the manufacture of an enormous quantity of material, must surely be of interest to the engineers and manufacturers of this country, even if it were being carried out in a foreign country, and still more so when it is being carried out in one of our great oversea Dominions.

In spite of the decision of the Royal Commission in regard to mechanical devices for overcoming the break-of-gauge difficulties, I think the problem might still be solved by such means, though it must be admitted that none of the mechanical devices brought forward up to the present time have offered a satisfactory solution.

1500-Volt 50-Cycle Rotary Converters.

HITHERTO it has usually been considered necessary when it is required to convert 50-cycle three-phase current into 1500-volt direct current to connect two 750-volt machines in series; but single armature, 1500-volt, 50-cycle rotary converters are now being built by the Oerlikon Company. One of these sets, which has recently been put into operation, is shown in Fig. 2. The normal rating is 375 kilowatts, but the machine will develop 420 kilowatts for half an hour and 600 kilowatts momentarily. In common with machines designed for lower working pressures, the armatures are provided with six slip rings and the field system is provided with a compound winding and interpole windings, designed in accordance with the Oerlikon patents. The main poles also have efficient damping windings, which serve for starting up the machine and also for preventing hunting. As all the windings are insulated to withstand the total pressure, it is unnecessary to mount the machines on insulators, and the frame of the converters is therefore earthed. Each converter has its own oil-immersed self-cooled transformer, which is rated at 400 kilowatts and is capable of withstanding overloads such as those previously mentioned.

By means of tappings on the secondary side of the transformer the converters are started as induction motors. When changing from the starting to the running connections by means of a starter of the oil-immersed drum type, a small choking coil is inserted in the circuit. As the machine starts up the field is energised and the direct-current pressure assumes the correct value when the set is switched on to the alternating-current bus-bars and when it is therefore running with the full alternating-current pressure. Furthermore, an automatic arrangement ensures that the polarity is correct, so that at the end of the starting period, which at the most is about 30 seconds, the converter is ready for work.

All the operator has to do when he desires to start one of these machines is to close the main high-tension switch and then operate the starter in the well-known manner. Owing to the simple way in which the machines are started, they are very suitable for use in automatic sub-stations. Pressure regulation is obtained by a three-phase choking coil, which is connected between the slip rings of the machines and their transformers, and, as is well known, it is possible with this arrangement to raise or lower the direct-current pressure by manipulating the field regulator, whilst the variation in the excitation produced by the compound winding also gives automatic regulation.

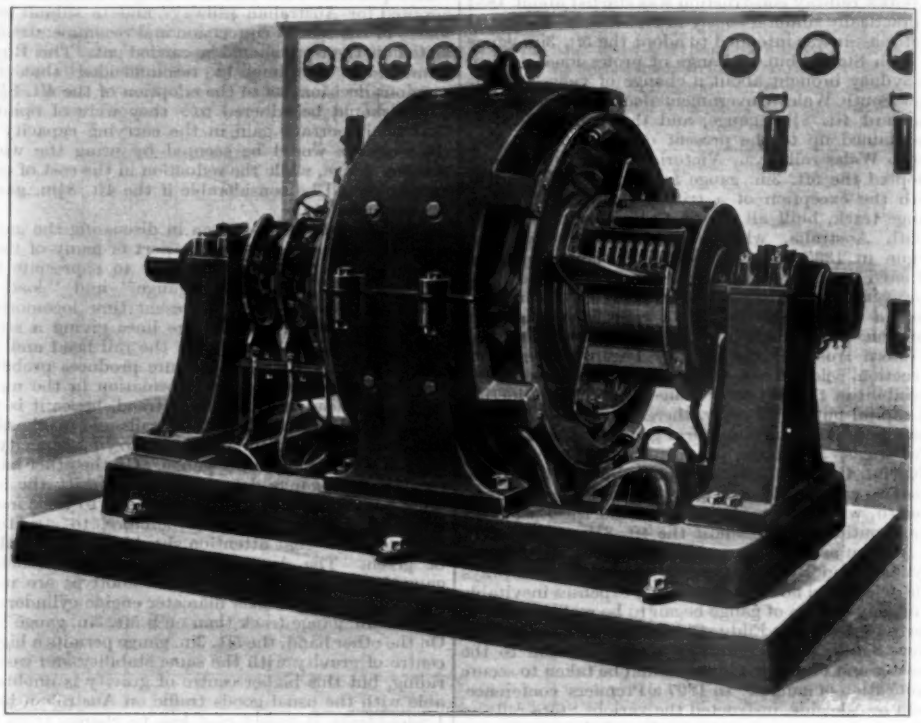


FIG. 2—1500-VOLT 50-CYCLE ROTARY CONVERTER

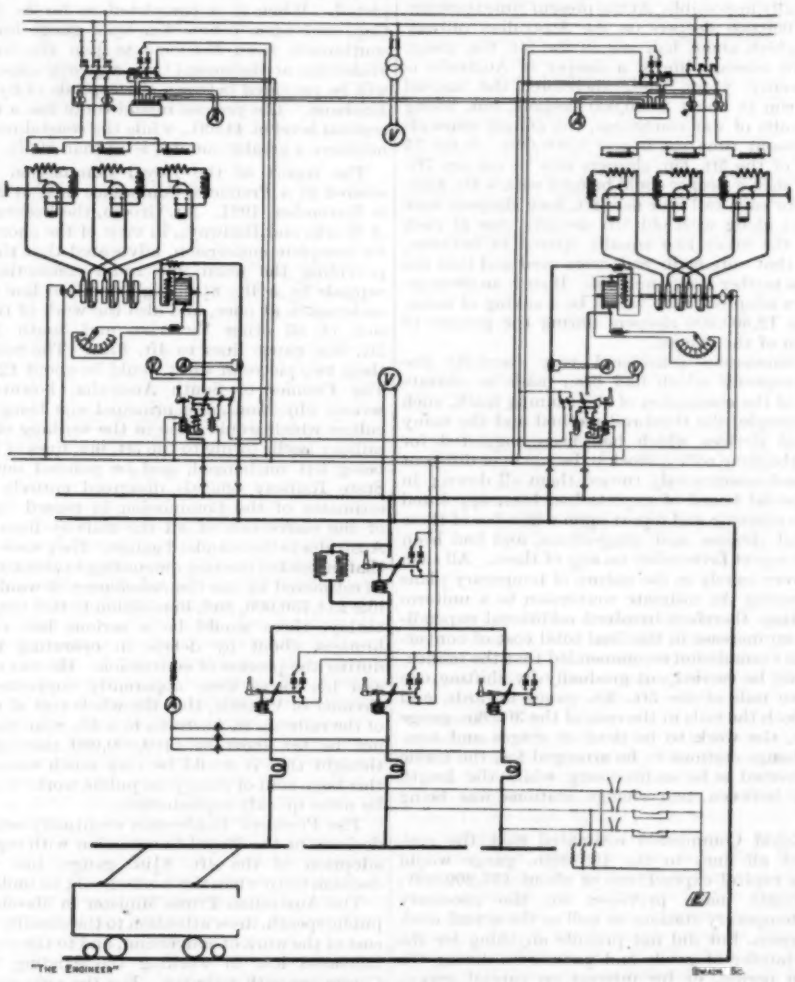


FIG. 1—DIAGRAM OF CONNECTIONS FOR TWO 1500-VOLT ROTARY CONVERTERS

It is well known that rotary converters which supply current to traction systems must be designed to behave satisfactorily under heavy overload and short-circuit conditions. One of the main things to be aimed at is the prevention of flashing over at the direct-current brushes at times of short circuits, and this has been one of the most difficult problems with which designers of these machines have had to grapple. As the tendency to flash over is governed by the duration of the short circuit current rather than by its maximum value, generally speaking, the more rapidly the circuit is broken the better will these machines behave under short-circuit conditions, and the less pronounced will be the damages which the short-circuit current causes. In view of the rapidity with which the short-circuit current increases, it is necessary to break the circuit within a two-hundredth or one-hundredth part of a second, otherwise trouble is likely to be experienced. For this purpose the Oerlikon Company has designed a quick-acting automatic circuit breaker, which has been tested with marked success in conjunction with the high-pressure converters under consideration. This circuit breaker is operated directly by the magnetic action of the current and without the use of relays or mechanical releases. Breakers designed on these lines, the makers explain, ensure that the switch is opened in the shortest possible time, for the magnetic field comes into play and increases instantly with the current and causes the circuit breaker to open instantaneously, whereas the operation of an automatic release with a relay introduces a time lag. To increase the rapidity of the break still further, the arc is blown out by a powerful magnet which is energised by the main current, and the quick-acting automatic circuit breaker necessarily opens instantaneously in the event of an excessive load as well as under short-circuit conditions. A resistance connected in parallel with the circuit breaker allows the main current to pass after the latter has opened, but keeps the value of the current within permissible limits, and in the event of an overload being maintained for an undesirable period the circuit is opened by the ordinary circuit breaker belonging to the converter. High-pressure rotary converters which have been tested in the Oerlikon works, however, have simply been fitted with quick-acting circuit breakers designed to deal with the full short-circuit current and without resistances connected in parallel with them.

Besides these short-circuit tests, trials have been carried out on high-pressure machines to determine the starting properties and also the behaviour under no-load, full-load and overload conditions, and to arrive at the efficiency and performance of the converters when converting direct current into alternating current, or, in other words, when running "inverted." It was found that the machines could be started up when the pressure at the slip rings was as low as one-seventh of the normal pressure, and that full speed could be reached within a period of 20 seconds. The starting current measured on the high-tension side of the transformers only amounted to about one-half of the full-load current, whilst the sparking at the direct-current brushes was insufficient to have any harmful effect. The energy absorbed when one of the machines was running with no load only amounted to 15 kilowatts. The efficiencies at various load are, of course, appreciably better than those of a motor generator. For the load test on the 1500-volt rotaries the Hopkinson method was employed, the plant being connected so that one machine ran as a three-phase to direct-current converter and supplied current to the second machine, which acted as a direct-current three-phase converter and fed back into the three-phase supply, the choking coils of the converting equipments being connected between the two machines. By regulating the direct-current pressure of one or of both the converters the load on the machines could be varied at will and either of the converters could be run inverted. During these Hopkinson tests and also during load tests with an external resistance it was possible to apply and remove the load suddenly without producing disturbances. A short-circuit test was also carried out whilst the machine was running light with full pressure across its terminals, and also whilst it was working at full load, and in the latter case the machine was left running at full load after the short circuit had been removed.

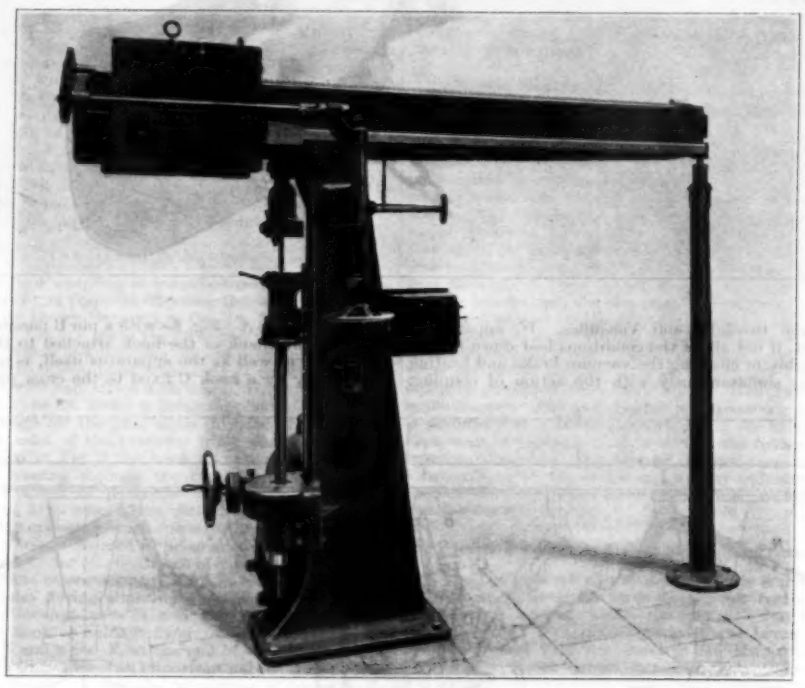
Two of these 1500-volt rotary converters have been

built for supplying direct current to the Frauenfeld-Wil Railway, and the plant is believed to be the first of its kind to be put into operation on the Continent. A diagram of connections for two of these machines is given in Fig. 1.

An Electrically Operated 15-Ton Testing Machine.

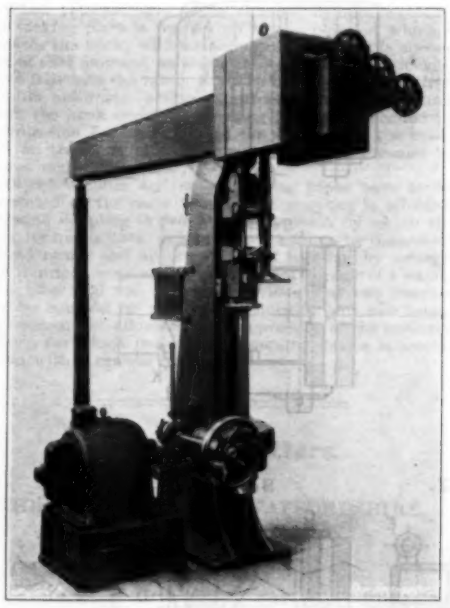
THE research department of Woolwich Arsenal has recently made an addition to its already well-equipped laboratory, by the provision of the testing machine illustrated herewith, which has been designed and specially constructed for the department by Messrs. W. and T. Avery, Limited, Birmingham.

The special requirements to be met in the case of this machine were that it should be capable of testing long specimens in tension and compression, and that the



AVERY'S 15-TON ELECTRICALLY OPERATED TESTING MACHINE

straining rate should cover a very wide range, the lowest speed not exceeding .05in. per minute. It was specified that the strain should be applied by a variable speed electric motor, the method of straining usually adopted by Messrs. Avery for their standard testing machines. It will be seen from the engraving that the poise is divided into two portions, one weighing 1008 lb. and the other



ARRANGEMENT OF ELECTRIC DRIVE

252 lb. These weights when coupled together range to the full capacity of the machine, namely, 15 tons by subdivisions of .01 tons. On locking the major portion of the poise to the steelyard and traversing the smaller portion, the steelyard readings range from zero to 3 tons by subdivisions of .001 tons.

The straining arrangements are such that the main speed is increased four times by means of the shunt regulator of the motor, but, in addition, change gears are provided so that the whole speed range is multiplied by five. This provision gives a complete speed range from .05in. per minute to 1in. per minute. In addition a hand drive is provided so that a still slower straining speed can be provided for compression tests. The tools for carrying out this latter test constitute a separate self-contained unit, and are inserted into the machine complete after the removal of the usual holders for tension tests. Specimens in tension can be tested up to a maximum stretched length of 24in., while specimens in compression can have an initial length of 24in. by 3in. square.

Cold Water Thawing in Placer Mining.

INFORMATION regarding the use of water at natural temperatures in the thawing of frozen gravel in placer mining operations is given in Technical Paper 309, by Charles Janin, consulting mining engineer, just published by the United States Bureau of Mines.

Experiments in cold water thawing demonstrate that under favourable conditions the process is an assured success. It is proving of great value to the gold-mining industry of Alaska and the Yukon Territory, and is encouraging investigation and exploitation of areas of frozen gravel that had been considered of too low grade for profitable mining.

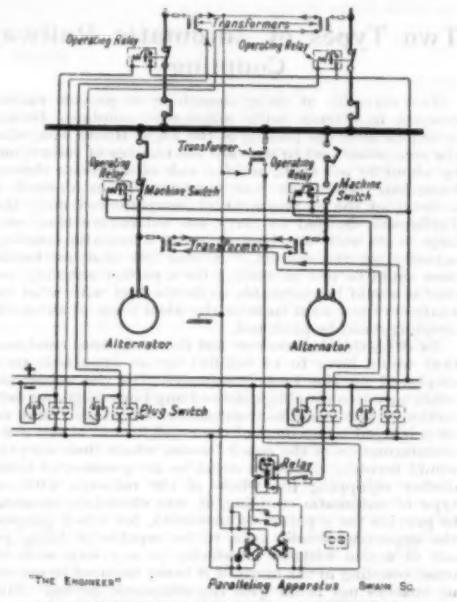
In placer mining in the far North one of the greatest difficulties encountered is the permanently frozen condition of the ground. In the early days of mining the ground was thawed by the primitive method of building wood fires on the surface, at the bottom of a shaft, or at the face of a drift. Although this method was slow and costly, a more effective one was not discovered until about 1898, when it was noticed that the steam escaping from the exhaust of a hoisting engine had thawed a hole in the solid "muck." Further experiments followed, and the direct application of steam through points proved so effective that it became the chief method adopted in thawing many millions of cubic yards of gravel for drift, surface mining, and dredging operations. Tests with hot-water thawing were made at different times. Experiments indicated that ground could be thawed by this method, but in comparison with steam thawing the latter was generally found more effective. At all events, no extensive thawing with hot water was ever done.

In all, many millions of cubic yards of frozen ground have been mined in the northern fields of Alaska and the Yukon Territory, as well as Siberia, by using various methods to soften or thaw the gravel. The most satisfactory method developed was thawing with steam points. This method, however, proved slow and costly under the most efficient management, its cost amounting in general to about 40 per cent. of the total cost of mining, and at some mines to perhaps 70 to 80 per cent. The high cost of thawing required that the gravel mined contain a higher gold content than ground that could be profitably mined where thawing was unnecessary, and prevented the working of the lower-grade ground in the frozen areas. The working of most of the deeper frozen or partly frozen ground seemed economically impossible except where drift mining would be profitable. A number of gravel areas in the far North have attracted mining men because of the high gold content as compared to dredgable areas of unfrozen ground in other districts. Little attempt to work much of this gravel has been made until recently, however, as no cheap method of thawing was known. Experiments have been made from time to time since the beginning of placer mining in the far North with the purpose of developing a more efficient method of thawing the frozen ground, and the files of the Patent Office show drawings of some peculiar machines designed for that purpose.

Between 1915 and 1917, different persons started experiments on an entirely new plan for thawing the frozen gravel. Water at the natural summer temperature was applied by drilling holes through the frozen muck and gravel to bedrock, and the water was allowed to find its way through the gravel back to the surface. This water was taken from surface ditches, or through pipes under pressure, or pressure was obtained by pumping. The results of these tests were very satisfactory. Although there is still much to be learned regarding practical application of the method, thawing with cold water has passed the experimental stage and is now proving of great value to the gold-mining industry. The successful application of this method where water is obtainable under pressure without pumping will make large areas of so-called low-grade ground available for dredging, and ground that has previously been considered to be of little or no value will now be of economic importance. Had the knowledge of this method of thawing been available to the Yukon Gold Company and other companies operating dredges in the far North during the past ten years, there might have been a considerable saving in costs and a correspondingly additional profit to those companies.

Automatic Synchronising Gear.

FROM time to time various kinds of automatic synchronising devices have been introduced for paralleling alternators in central stations, but as far as this country is concerned, the usual method of paralleling by means of synchroscopes is generally adhered to. Brown, Boveri and Co. have, however, introduced an automatic synchronising equipment, which is claimed to operate very satisfactorily, and which has been in daily operation in the Aarau power-house for a period of two years. The apparatus, which is shown in the accompanying diagram, serves for interconnecting the Aarau power station with another station at Olten-Aarbourg, and we are told that it has never given the slightest trouble. Experience has shown conclusively that paralleling with the aid of this device is more precise and rapid than that which can be obtained by hand, and in consequence of the very small



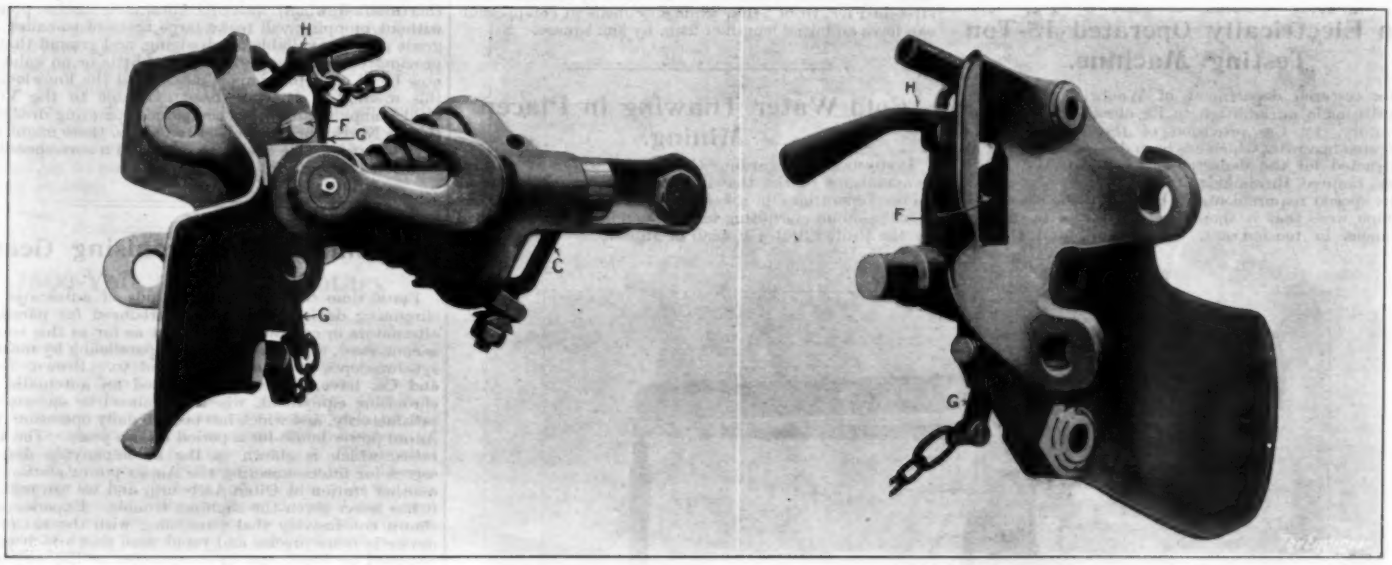
SYNCHRONISING GEARS FOR ALTERNATORS

difference in phase which exists at the moment the machines are coupled together, the harmful electrical and mechanical effects which are liable to result from a large phase difference are eliminated. Whilst operators may miss the proper moment at which the switch should be closed, the Brown-Boveri synchroniser always takes advantage of the first instant of synchronism, and thus often avoids loss of time. The device can, of course, be used for paralleling synchronous motors, as well as alternators and power stations.

From the diagram it will be perceived that the paralleling apparatus is constructed on the same principle as the Brown-Boveri voltage regulator, which has already been described in these columns. The coils of the movable parts are connected in one case by a plug switch to the bus-bars and in the other case to the generator to be paralleled. Whenever there is a difference in the frequency of the machines already at work and the machine that is about to be paralleled, the movable member of the regulator oscillates between two extreme positions, and small lamps show whether the speed should be increased or diminished. As the two frequencies become more equal to one another, the oscillating movement of the instrument diminishes, but whenever there is a difference of phase between the voltages of the running machine and the incoming generator, the position of the moving sectors deviates from the mean position, thereby increasing the resistance in the circuit, and reducing the current passing through the time limit relay, to be seen in the lower part of the diagram. If the two frequencies are nearly equal, the moving elements will remain long enough in this intermediate position to allow the relay to close its contacts and to close the relay which operates the main switch. In order to compensate the time lag, the apparatus is designed so that the contact sectors are always in advance of the other movable parts, so that the phase angle between the two voltages is reduced to a minimum at the time the switch closes. Obviously, synchronising gear of this description eliminates the usual devices used for paralleling purposes, such as synchroscopes, synchronising lamps, &c., and, as shown in the diagram, it is possible with the aid of plug switches to make the apparatus parallel machines on the station bus-bars or to connect two stations together. The energising current for the relays, it will be noticed, is taken from a direct-current circuit.

THE BOIRAULT AUTOMATIC RAILWAY COUPLING

SOCIETE DES APPAREILS BOIRAULT, PARIS, ENGINEERS



Two Types of Automatic Railway Coupling.

THE necessity of doing something to provide railway coaches in France with automatic couplings became so urgent after the passing of the Eight Hours' law, when the companies had to increase the number of railwaymen by about 30 per cent., and the risk of accidents through hazardous operations was considerably augmented as a result of the employment of inexperienced men, that Parliament decided to carry out exhaustive tests on a large scale with the best types of automatic couplings actually on the market. It was felt that no further time could be lost in waiting for a perfect coupling, and that it would be preferable to do the best with what was available until such time as the ideal form of automatic coupling could be produced.

In 1912, the Government laid down eighteen conditions that would have to be fulfilled by an apparatus to be employed on the French railways. In the subsequent trials only two couplings showed any hope of giving satisfaction. The American automatic couplings could not be employed on account of their weight and of the costly transformation of the coach frames, which their adoption would involve. As there could be no question of immediately equipping the whole of the railways with one type of automatic coupling, it was obviously necessary to provide for a period of transition, for which purpose, the apparatus would have to be capable of being put out of action without interfering in any way with the usual coupling in the event of it being required to connect up coaches not fitted with the automatic device. After

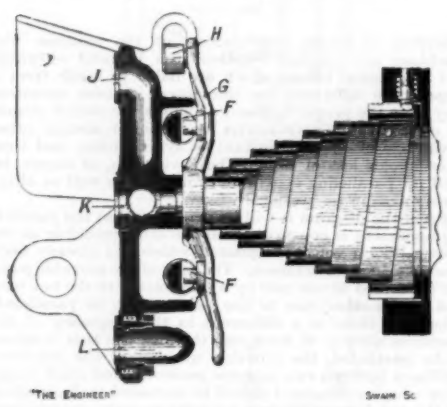


FIG. 1—SECTION OF BOIRAULT COUPLING

the Armistice, the Chamber of Deputies voted a sum of 20 million francs for carrying out preliminary tests and for equipping a certain number of coaches with the apparatus that gave the best results.

The Boirault and Henricot couplings, having gone through pre-war tests and being already employed in practical use to a limited extent, were not included in the preliminary trials which were intended to sift out anything promising amongst the considerable amount of apparatus that was presented. Only five types were regarded as worthy of a test, and none of them came up to anything like the standard required. It was, therefore, decided to carry out the trials on a large scale with the Boirault and Henricot couplings. We are informed that orders for 10,000 Boirault couplings are now being placed for the State Railways.

THE BOIRAULT COUPLING.

The automatic coupling constructed by the Société des Appareils Boirault, 58, Rue Taitbout, Paris, was brought out by the French railway engineer of that name in 1900, and is already fitted to the electric trains running between the Invalides and Versailles. It, apparently, fulfils most, if not all, of the conditions laid down by the State, notably in effecting the vacuum brake and heating connections simultaneously with the action of coupling

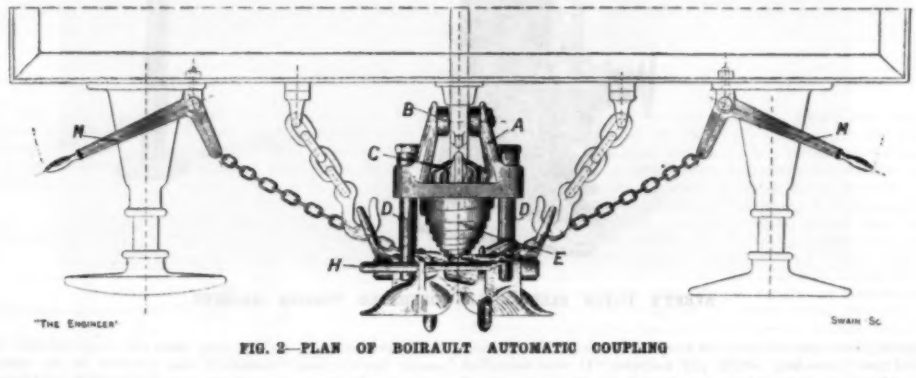


FIG. 2—PLAN OF BOIRAULT AUTOMATIC COUPLING

up the coaches. Both parts of the coupling are symmetrical. Each coupling head is dished with two wings. The wings of both coupling heads fit together at right angles, and are curved in such a way that in the event of

is a forged piece A—Fig. 2—with a pin B passing through a hole in the shank of the hook attached to the wagon. The frame, as well as the apparatus itself, is maintained horizontally by a hook C fixed to the cross piece of the frame and passing over the ordinary coupling hook. At each side of the frame holes are drilled for two slide guides D D attached to the coupling head. Between the coupling head and the frame is a powerful conical spring

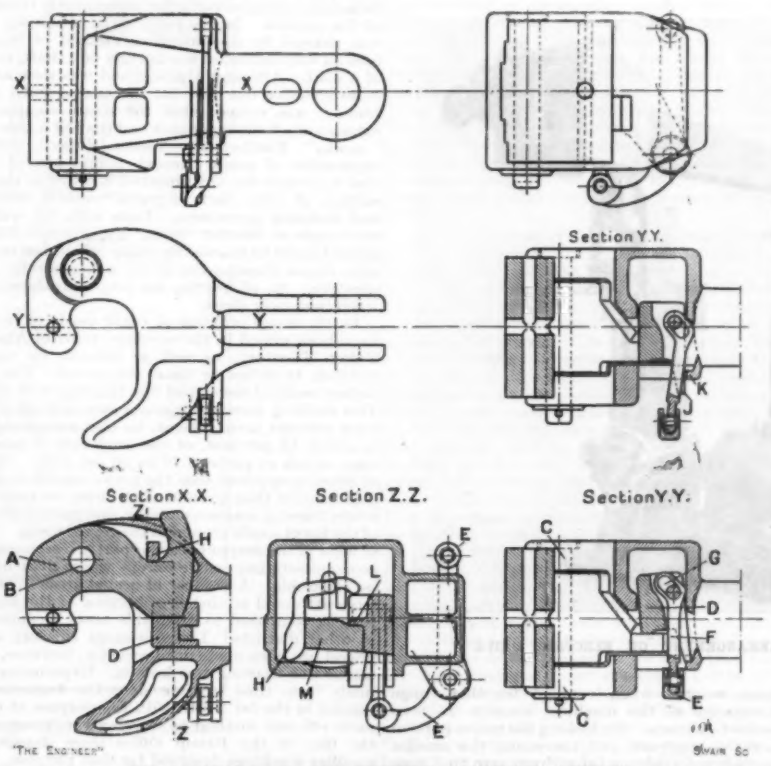


FIG. 3—DETAILS OF THE HENRICOT AUTOMATIC COUPLING

one being lower than the other they will slide axially into position, when the two parts are automatically locked.

The apparatus consists of two main parts—a spring or buffer frame and a coupling piece. The buffer frame

E which, while acting as a buffer, exerts pressure on the locking rocker. The frame is stayed on each side by the existing chains fixed to the wagon. In the coupling head, a single steel casting, are two heavy section bolts F F—Fig. 1—actuated by the rocker G with which

they are connected by pins engaging in grooves milled in the bolts. A high torsional moment is exerted by the spring on the rocker to push the bolts into the locking position. When uncoupled, the rocker is held back by a catch H hinged to its extremity, this catch being knocked up and released by the bevelled end of the projection of the other coupling when engaging. The locking holes of the two heads are made to coincide accurately by the curvature of the wings. Fig. 1 gives a sectional view of the apparatus without the buffer frame and shows the couplings J, K, and L respectively for the vacuum and air brakes and for the steam heating pipe.

The wagons are uncoupled by means of the levers M—Fig. 2—and chains attached to the rocker which, on being drawn back against the torsion of the spring, withdraws the bolts in the coupling heads and is kept back by the catch lever. On the two coupling heads coming together, their bevel projections engage under the catch levers, which are raised, and the rockers push the bolts through the holes. As it is an indispensible condition that the apparatus should not work while vehicles are being shunted and no coupling is required, the catch lever can be raised to permit of the rocker pushing the bolts through the holes. The projections of the other coupling then strike the bolts without engaging. As the shock is taken up by the spring, there is claimed to be no risk of damage, a fact shown by the result of experiments, during which the bolts have been replaced by pieces of wood. The apparatus here described is a transition type, and is such, that when a wagon fitted with the apparatus has to be coupled with a vehicle having an ordinary coupling, the automatic apparatus can be unhooked and will remain suspended from the frame without interfering with the coupling up of both wagons. The final design, when adopted on an entire railway system, provides for the suppression of the ordinary buffers.

THE HENRICOT COUPLING.

The Henricot coupling is manufactured by the Usines Emile Henricot, of Court-St.-Etienne, Belgium, represented in France by Henry Bergerat et Cie, 10, Rue Sèze, Paris. M. Henricot has for more than twenty years specialised in the production of automatic railway couplings and has, we are informed, equipped thousands of railway vehicles in Asia, America and Africa with them. His latest pattern is known as type IX. which is being supplied to the French State Railways for the final trials in place of type VIII. with which most of the previous trials were carried out. As illustrated in Fig. 3 the hook or knuckle A turns on the pin B passing through the coupling body C. The hook has a shank of particular form on which acts a locking piece D in association with a lever H, known as the "knuckle opener," which opens out the hook for coupling. The whole is claimed to be so arranged as to ensure a perfect lock under all conditions of vibration and shock, and a complete disengagement when it is not required to couple vehicles during shunting operations. The movement of the locking piece D, acting on the shank, either releases the hook or holds it fixed. The lock is actuated by a lever E and a rod F, at the end of which is an elongated hole G which plays an important part in the working of the apparatus. When the apparatus is locked, the rod F slips back on a pin in the locking piece D until the shoulder of the rod passes through an aperture in the coupling body, against which it thrusts to prevent the locking piece from disengaging the hook under the effects of vibration or shock. When the lever E is moved to open the coupling, the rod F rises on the pin and takes up the position inside the locking piece shown in the lower right hand section, which piece is now free to move upwards and release the hook. The locking piece then pushes against the small arm of the knuckle opener H which, pulling on the long arm of the hook, opens it out for coupling.

When vehicles have to be shunted without coupling, the locking piece is pushed up to the point at which it releases the hook, without acting on the knuckle opener, and at that moment, an arm J projecting from the locking piece falls into the notch K. The apparatus is now free, and its automatic action suppressed. In this position, when the hook opens, the locking piece is suspended by a projection L which rests on the shank M of the hook, and on the hook closing, the locking piece resumes its former neutral position.

As the vacuum and steam heating pipes have to be connected at the same time as the coupling is effected, a second coupling is provided underneath by which the pipe terminals are guided into position by means of curved ramps and are kept pressed together by springs. The Henricot coupling is actuated from the side of a wagon by a lever and rod, and it is obvious that two coaches can be coupled or released by opening out one hook. The system also allows for the suppression of the ordinary buffers, for which purpose the coupling device is associated with a central buffer.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Steel Position.

INTEREST in iron and steel and engineering circles hereabouts this week centres principally in the steel department in which, particularly in the case of sections, competition for the sparse amount of business in sight has become keen. Prices have not settled yet after the upheaval caused by the decontrol. Producers are feeling their way cautiously, leading houses in this district taking a line of their own. Customers look for still further concessions. This area, however, is not now subject to the keen competition from the North-East Coast which was a feature some time ago, the northern steel makers finding it unprofitable, in view of the heavy carriage charges. A weakening tendency is perceptible in regard to angles and tees. Angles have been offered at £8 15s., though the quotation of £9 is not definitely superseded. Joists and plates are unaltered. Staffordshire steel hoops are now on the £11 10s. mark, but reduced rates have given impetus to trade, which is at a low ebb. The feature in semis is the break in sheet bars, which has become accentuated during the past week. Recently sheet bars and mild steel billets were up to £7 7s. 6d. and even £7 10s.; now they are no higher than £7 5s. As a matter of fact, supplies are stated to have been offered this week at £6 17s. 6d., and in some instances £6 15s. is said to have been accepted. Billets stand at £7 2s. 6d. and upwards, a figure which leaves little opening for Belgian competition. But a good deal of finished steel is coming in, especially in the form of joists, which can be bought at £6 12s. 6d. in Antwerp or about £8 in Birmingham, competing with English at £9. For exacting requirements this steel is unsuitable, but fairly large quantities have been bought by importing merchants carrying stocks for ordinary building purposes. There are indications that North and South Staffordshire steel works have an understanding as to prices, their quotation for constructional steel such as angles and sections having lately been uniform. Similar quotations are being received from Lincolnshire, which is also a source of steel supply for the Midlands. Northern steel works not being keen about contracts in this district, Midland manufacturers are able to command the business on the basis of agreed prices.

Finished Iron.

The Staffordshire finished iron trade shows little change, and the works generally are not producing more than 50 per cent. capacity. There are great complaints of unprofitable production. On the export side business is curtailed by the tangled maze of international affairs, and at home it is waiting a development of the autumn trade. The Lancashire area gets a larger share of the export business, particularly in baling hoops and cotton ties, aided by the position of the works on the seaboard. The local works are a shade busier, but makers of finished iron have still to meet severe Belgian competition in No. 3 bars, chiefly used for nut and bolt making, which can be bought here at £8 12s. 6d. Nut and bolt bars have not been bought in anything like such large quantities of late. With the Darlaston and Wednesbury wakes over, however, some revival of activity is in prospect, and a few anticipatory purchases have been made. The price position is unchanged. For best grades of engineering iron there is perhaps just a little more inquiry. As to the actual expansion of business, that is still in the future. Better reports from the shipbuilding centres are imparting a better tone to the chain and anchor industries in the Cradley district, which have been under a cloud of depression for a long time.

Further Advance in Galvanised Sheet Prices.

The firmness of galvanised sheets is maintained. Midland manufacturers have this week further raised their prices, leading works quoting £17 for 24 gauge sheets and £21 10s. for 30 gauge f.o.b. Liverpool. To Midland buyers they are quoting £16 15s., although in some cases easier prices are accepted. The present demand suffices to employ only about half the productive capacity in this district, so that sellers have done well to rally the market to the extent lately noted.

Improved Demand for Pig Iron.

The demand for pig iron has improved a little, although makers still complain of the small tonnages involved in the business offered. The aggregate, however, is enabling Midland furnaces to dispose of their output. Confidence is not yet sufficient to lead to forward buying. The effort to obtain higher prices to cover the increased cost of coke has not been successful, although, generally speaking, prices are somewhat firmer on the recent basis. The scarcity of coke has been relieved a little and prices are not quite so firm as they were. The large merchants state that they do not propose to increase their prices to blast-furnaces, being content to secure something like 5s. per ton more from their foreign customers. Smelters are hoping that the fuel market will soon become normal.

Midland Miners' Wages.

Miners in the Eastern area are to receive a slight advance in wages during the month of September. The Wages Board have fixed the percentage addition to the basis rates at 36.19, an increase of 4.19 per cent. This means that the minimum wage for stallmen will be 3d. per day higher than in August, viz., 8s. 11d. as against 8s. 8d. The area referred to comprises Yorkshire, Notts, Derbyshire, Leicestershire, Cannock Chase, and Warwickshire.

Unemployed in the Midlands.

As an indication of the state of trade the recent figures of the labour exchange are of interest. There was a slight fall in the aggregate figures in respect of unemployment in the West Midland area for August 28th, as compared with a week earlier. The total figures are 182,912 as against 183,689. At Birmingham, Coventry, Wolverhampton, Dudley, Wednesbury, and Darlaston, the number of unemployed increased, but a falling off was particularly noticeable in the pottery towns. There was a substantial fall from 8176 to 7150 at Cradley Heath, and decreases at West Bromwich, Walsall, and Smethwick.

Big Rail Order for a Birmingham Firm.

Much satisfaction is expressed at the success of the Metropolitan Carriage, Wagon, and Finance Company, Limited, of Saltley, Birmingham, in securing the contract for the manufacture of 448 covered goods wagons required by the Burma Railways. It will mean a good deal of work for this district, and considerable quantities of material will be required. The company, it is understood, has also been successful in its recent tender for the supply of 270 ballast wagons for the South Indian Railway.

Obituary.

Mr. J. Amos Lloyd, Compton, Wolverhampton, a gentleman well known and respected in South Staffordshire engineering and business circles, has passed away. Mr. Lloyd received his early business training in the iron and steel trades, which fitted him for a secretarial position, which he took up with John Brotherton, Limited, Wolverhampton, thirty years ago. From secretary he rose to managing director, and was actively engaged in business until about a month ago. He was a past-president of the Council of the Wolverhampton Chamber of Commerce, and had held the office of hon. vice-president of the Association of Chambers of Commerce and chairman of the Committee for Home Affairs and Transport.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Conditions.

THE markets here for both ferrous and non-ferrous metals are all dull, and one might almost call them depressed. The expectation of an autumn revival is fading, and it was never based on anything at all substantial. It is proverbial that the continual postponement of hope "maketh the heart sick," and this is a very effective description of the metal markets at the present moment. People are tired of waiting for what never comes, and any optimistic reports are now received here with considerable irritation. The retail character of most of the trading involves the maximum of work and trouble with the minimum of profit, and the trade looks back with longing to the time when consumers had the courage to buy in large quantities. There does not seem to be any definite expectation amongst consumers of a fall in the current prices, but any confidence which may exist as to the stability of the markets does not seem to be translated into action. The feeling seems to be that although prices may not fall, there is not the slightest probability of any rise which it may be worth while to anticipate.

Metals.

No changes have yet been made in the official prices for manufactured copper and brass, nor is there any indication that the control of prices in this department of industry is likely to be relaxed, and that metal manufacturers are about to follow the example of steel manufacturers. The trade of metal manufacture is, of course, contained in a smaller compass than that of steel production, and consequently it is easier to keep it under control; but it must be admitted that the present range of prices acts in restriction of trade, and that while the profits are high, the output is low. One cannot say exactly to what extent production of manufactured metals has been reduced in this country as a result of prices, but it must be very considerable. Indeed, the excuse for heavy margins, as in the case of copper and brass tubes, is that the costs of manufacturing are so high, and these are high because the machinery is not fully employed. That the home consumer is forced to pay extravagant prices is shown by the official figures; as, for instance, that copper "braziers" for India are quoted at £83 per ton, while 4ft. by 4ft. sheets for the home market are quoted at £94 per ton. In a normal condition of the market, these prices ought to be on a level. Again, sheet brass is quoted at 10d. per lb. for 4ft. by 2ft. sheets—equal to £93 6s. 8d. per ton. In a free market this material would now be at about £75 per ton. The standard copper market made some little recovery on the news that the difficulty between France and Germany had been postponed for two or three months. The idea is that the German exchange will allow of the resumption of the buying of copper, and some buying has been done also by France. The American market is steady, and if the industrial troubles are now nearly over in that country, as may be reasonably hoped, it is probable that consumption will begin to improve. Tin has been rather a better market lately, but the outlook is still very uncertain. Manchester consumers do not seem inclined to take a favourable view, but, of course, the Manchester market for tin is a very small one, and the attitude here has little effect on market prospects. The dangerous point about tin is that current production is fully equal to the world's needs, and there is no prospect of reducing the accumulations in the East. The demand for lead has been fairly steady, and the quantity coming into British markets is not excessive. The market opinion seems to be in favour of steady prices for some time yet. The demand for spelter is fairly good, and the supplies are only small. The make of British spelter seems to be increasing; but there is little supply from the Continent, Belgium selling only sparingly and Germany offering practically nothing.

Pig Iron.

There have been rumours of improvement in the markets for pig iron from other centres of the trade, but these seem to be received with some scepticism here in the absence of any movement in the Northern Midlands. The demand for foundry iron is steady and consumers pay the present price of 90s. delivered quite willingly, and do not seem to anticipate any immediate change. There have been some sales for three months' delivery, but as a rule the buying is from hand to mouth, or for delivery during the present month. The reports of improvement in Scotland, Cumberland and Cleveland seem all to be caused by the American demand, and this may cease at any moment. It is said that the Cleveland makers are about to blow in five or six more furnaces in order to meet the demand from America, and this may prove a dangerous course, unless that demand is maintained for some months. The price of Scotch iron in Manchester—now 120s. per ton delivered for No. 3—is causing a great deal of dissatisfaction amongst founders here. It is difficult to do without it for a good deal of the work in this district, but the consumer keenly resents having to pay 30s. per ton more for it than for common foundry iron. The reports of shipments of hematite to America may lead to an increase in the price of this class of iron, but at present it can be bought in Manchester at about 15s. per ton below Scotch.

Finished Material.

Here the prices quoted for steel plates and sections are unchanged, and the orders given out are almost all for small lots and for immediate delivery. There are reports of larger orders for steel plates being taken by the East Coast works, but if the prices reported be true, there can be very little satisfaction about this business. Here sellers of ordinary steel plates are trying to keep the price up to £10 per ton.

Scrap.

The demand for scrap of all kinds remains very poor. It is said that some of the ironworks will not pay more than 65s. per ton for good heavy wrought scrap, and this is not a price which can pay the scrap merchant. Cast scrap is weak, and for common ordinary qualities about 75s. to 77s. 6d. per ton is about the selling value. For broken textile machinery castings more can be obtained, but the market all round is very much restricted. Steel scrap is almost unsaleable here, partly owing to the high cost of railway carriage. About 47s. 6d. per ton seems to be about the value.

The Engineering Industry.

It cannot be said that engineering firms in this district have yet found much improvement in trade following the two reductions in the workers' war bonus which have already taken place. It was indeed scarcely likely that these reductions would have the much-desired effect on order books so soon; but inquiries for goods are, I am told, coming in much more freely than has recently been the case. As I have previously suggested, there are, no doubt, many orders still being held up by prospective purchasers who are waiting till they consider that prices have "reached bottom." In an industry like engineering, with so many diverse branches and working under such different conditions, it is, of course, impossible to obtain anything like uniformity, but generally speaking it seems unlikely that engineers can cut their prices any further, owing to the increased cost of the raw products. A further probable reason for the lack of improvement is the holiday season, which seems to be more attenuated than usual this year. The present month will probably show whether there is any foundation for the hope of improvement. A spurt in shipbuilding would have a very agreeable effect. In constructional engineering and building, there has been a very decided fall in prices during the last six months or so, and it is scarcely likely that there will be any further reduction in this branch for some time to come; in fact, the tendency may be in the other direction, and I would advise firms contemplating extensions not to delay much longer.

Manchester Association of Engineers.

The opening meeting of the forthcoming session of the above society will take place on October 13th, when Mr. Daniel Adamson will give his presidential address. Two visits to works in this neighbourhood have also been arranged, one on the 27th inst. to the works of the Metropolitan-Vickers Electrical Company, Limited, and the other on October 14th to the Barton electricity station, the structure of which is now rapidly approaching completion.

The Engineers' Club.

The first portion of the extensions of the Manchester Engineers' Club is now nearly finished, and it is anticipated that it will be ready for occupation by the end of the present month.

BARROW-IN-FURNESS, Thursday.

Hematite.

America has become a customer for West Coast hematite iron, and the first cargo of pig iron of about 5000 tons leaves Barrow this week. There is more to follow, and it is understood that several vessels have been chartered to convey it across in the next few weeks. This first cargo is for Baltimore. This is an interesting development, for trade between this district and America has been noticeable by its absence for a considerable time. Probably the coal strike in America has something to do with it, although the hopes in this part of the iron industry are that trade is reviving and that it may continue. The Millom works are supplying the major portion of the first consignments, the North Lonsdale works at Ulverston delivering the remainder. These orders will be the means of reducing present stocks, and will mean more furnaces being put in blast sooner than was expected. Otherwise trade is slowly improving, and there is an increasing inquiry from the Continent. As engineers and other manufacturers in this country get to work, the orders will increase in bulk. Special iron is in better demand, already there is a small trade in spiegel, and ferro-manganese is finding customers in America and the Continent.

Iron Ore.

There is more hope for the iron ore industry, now that stocks are being so substantially reduced, and as soon as more furnaces are put in operation, so will the consumption of native sorts increase. The same remark applies to foreign sorts which at present are not in heavy demand. A few small cargoes are being shipped for British ports.

Steel.

The steel trade continues fairly well employed in the rail departments, but fresh orders will be soon required in order to carry on. There are some inquiries, but the competition is keen. The hoop mills are clear of their American contracts, and are only fairly employed. The foundries are partly engaged. There is little life in billets, and nothing in ship plates.

Shipbuilding and Engineering.

The reconditioned Holt liner (ex-German Brandenburg) has left Barrow completed, and the Australian Commonwealth liner Jervis Bay, the last of the three ships Messrs. Vickers contracted for, has also left for Liverpool to dry dock, previous to her proceeding to London to take up her station later on this month. The Anglo-American tanker Narragansett is at Barrow for overhaul.

SHEFFIELD.

(From our own Correspondent.)

Moving Slowly.

SHEFFIELD's trade revival is still a painfully slow process, and the first few days of September have not brought the predicted autumn boom any nearer realisation. Orders for steel are being placed a trifle more freely, but still on a very restricted scale, buyers evidently being very diffident about the future. None of the big contracts recently placed in connection with public works in various parts of the world have come this way, though some crumbs are hoped for in the shape of orders for steel required in the execution of these contracts. Vickers, it is true, have obtained an order for water turbines and electrical plant for the development of power from a low head fall on the Bari Doab Canal, Punjab, and doubtless part of this work will come to the Sheffield branches of Vickers and their associated electrical concern, Metropolitan-Vickers. The latter, by the way, are just beginning to be busy in connection with the million pounds contract for the electrification of a section of the South African railways, particulars of which have previously appeared in these columns. Another contract in which Vickers will be interested is that for the manufacture of 448 covered goods wagons for the Burma Railways, which has just been awarded the Metropolitan Carriage, Wagon and Finance Company, which concern it may be recalled is one of Vickers' most successful subsidiary companies, and one upon whose earnings the parent company was largely dependent for the payment of the last dividend. This company has also been successful in the recent tender for the supply of 270 ballast wagons for the South Indian Railway. Another direction in which Vickers hope to be busy in the near future is in the supply of many motor car parts in which steel of high grade is used, such as crank shafts and axles. Another of their subsidiary concerns, Wolseley Motors, is making a big bid for the capture of a larger share of the trade for this country, and in addition to this demand Vickers supply a large number of parts for other first-class cars.

Waiting for Armament Orders.

Unfortunately many Sheffield steel makers and rolling mill firms are still looking for the placing of orders for armaments as a means of restoring prosperity, instead of turning to other possibly less lucrative but more lasting forms of employment. Responding to the clamorous demand of those people who have come to the conclusion that Sheffield's only hope is the continued manufacture of material for future wars, the Lord Mayor is joining with the civic heads of other armament centres in appealing to the Prime Minister to give out the orders for the construction of two battle cruisers. The appeal will be presented to Mr. Lloyd George at an early date, and an urgent request will be made that the Government will expedite the commencement of the building of the battle cruisers in order to reduce the unemployment in Sheffield and the other large industrial centres concerned. Vickers' Barrow shipyard, it is said, is now without any new construction work in hand, and this inactivity, of course, is reflected in a reduced demand for steel from their Sheffield works. Another indication of the lessened demand for steel is found in the fact that large consignments of pig iron are going to America. At the same time there is a certain amount of improvement in some of the local steel works, notably in the Siemens steel department for cheap basic billets. Furnaces are working at greatly varying degrees, however; in some cases they are reported to be up to 60 per cent. capacity, while in others, the output is not more than 25 per cent. The reduction in working costs brought about by the bonus cuts has been to some extent counterbalanced by increased cost of coke for blast-furnaces, which in some cases amounts to a 2s. advance. The crucible steel departments are also, in some cases, a little busier, which may be regarded as a promising indication of increased activity in the engineering shops. This demand is in part due to the absorption of the enormous Government surplus stocks, which have for a long time past met most of the requirements for this class of steel, and as a consequence kept the price at very low levels. Makers are, however, gratified to learn that at last this serious competition seems to be within measurable distance of extinction. In mild steel the Sheffield makers have still to meet formidable competition from centres where costs of production are substantially lower, and which have not the handicap imposed by local rates amounting to 23s. in the £.

Varied Experiences.

Generally speaking, in all departments, local firms are feeling the stringency of money, and one of the most distressing features of the past week's events has been a meeting of the creditors of one of the oldest firms in the edge tool trade which has gone into voluntary liquidation. In another case there has been a meeting of the staff and employees with the directors, who put the position before them with the utmost frankness, and pleaded for a voluntary reduction in salaries and wages. It is feared these cases are merely symtomatic of a fairly widespread condition of affairs, and unless things rapidly improve, there will inevitably be a most serious winter for Sheffield people. From this depressing outlook it is a relief to turn to a couple of instances that seem to inspire a little more hope. Two Sheffield companies have been able to show substantial balances on the right side as a result of their operations in the financial year ended June 30th. Messrs. Ibbotson Brothers and Company, Limited, of the Globe Steel Works, show a profit of £27,670, and repeat their dividend of 10 per cent. At the same time the directors report that it is now difficult to obtain sufficient orders to pay expenses. The Hardy Patent Pick Company, Ltd., show a profit of over £9000, and are paying 7 per cent., as compared with 10 per cent. the previous year; in this case, however, the profits were £23,639. This company specialises in the manufacture of mining tools and agricultural implements, and these departments have been fairly busy for some time past, though here again there is a serious falling off in orders now being placed.

Better News from Lincolnshire.

There is distinctly more encouraging news from Lincolnshire. The Normanby Park Steel Works of John Lysaght, Limited, are working full time on sheet bars and billets, with three blast-furnaces and five out of their six steel furnaces going. The Frodingham Iron and Steel Company, Limited, is also busy, and considerable developments are contemplated at the Redbourn Hill Iron and Steel Works. Not only are the steel and iron-works well employed, but the Lincoln engineering shops have been showing distinct signs of revival. Clayton Wagons, Limited, for instance, have contracts for twenty-five bogie rail and timber wagons for the metre-gauge line of the Assam-Bengal Railway, twenty-five rail wagons for the London and South-Western Railway, eight bogie passenger carriages for the Caledonian Railway, two bogie sleeping carriages for the Buenos Aires Midland Railway, and five bogie carriage underframes for the 2ft. 6in. gauge lines of the Bengal-Nagpur Railway.

Coal and Coke Demand Improves.

Miners in the eastern area—in which most of the local pits are situated will receive a slight advance as a result of the ascertainment made at the week-end by the Wages Board at Derby, the percentage addition to the basis rates being fixed at 36.19 points, an increase of 4.19 per cent. The whole output of the pits is now going away day by day, the export trade being distinctly brisk. The demand for best hard coal continues good; slacks maintain their recent good position, and prices show a hardening tendency. The continued export demand for coke restricts supplies for the home market, with the result that the home price has stiffened, up to 20s. being paid at the ovens, while for shipment, foundry and furnace coke is fetching up to 30s. At the annual meeting of the Midland Institute of Mining, Civil and Mechanical Engineers, held at the University of Sheffield, a membership of 530 was reported, and officers elected as follows: President, Colonel Harry Rhodes; Vice-presidents, Messrs. G. H. Ashwin, Robert Clive, and John Gill; Council, Messrs. J. E. Chambers, W. J. Charlton, D. H. Curror-Briggs, Professor W. G. Fearnsides, L. C. Parkin, and B. H. Pickering.

NORTH OF ENGLAND.

(From our own Correspondent.)

Brighter Promise of Trade Revival.

WHILE it is difficult to predict with any certainty the prospects for the autumn months, there are indications, faint perhaps at the moment, but none the less appreciable and welcome, of a gently-reviving activity and the position is certainly more hopeful. In the iron and steel trade the latest official statistics reveal a pronounced increase in production, and although August is usually a slack month, owing to the general interruption of industrial operations through the holidays, it is gratifying to find in reviewing the return of exports from the Cleveland district that the level of the previous month was maintained. In the case of the pig iron exports this has been due to the heavy trade with the United States, and in the manufactured iron and steel branch of the trade the improved business with India and Australia is mainly responsible. To the United States alone, 9862 tons of pig iron were shipped, and except for the 16,025 tons exported in June last, this figure has not been equalled since long before the outbreak of war. Moreover, further heavy sales have already been made for Transatlantic shipment, and it may well prove that the August figures will be surpassed by the current month's total. Despite the exchange difficulties, 2680 tons of pig iron were shipped to Germany, but to other foreign ports the volume of trade showed little change, although it is gratifying to note that the Italian trade was maintained at a level of over 4000 tons. Though active competitors, Belgian and France received supplies from Cleveland, aggregating 3096 tons and 1420 ton respectively. Wales was a large customer with 5060 tons, and 3150 tons were sent to Scotland. An encouraging feature of the steel trade is the number of avenues which have been opened up for the disposal of manufactures. All the South American Republics are now regular customers, and Syria, Siam, Finland, Esthonia, and Turkey are amongst the occasional customers. The British Overseas Dominions and self-governing Colonies, however, still continue to be Cleveland's chief buyers. The exports to India and Ceylon totalled 11,815 tons, which represented an increase of over 2000 tons, and 5783 tons shipped to Australia was the biggest monthly total of the year.

Cleveland Iron Trade.

There are evident signs of activity in the Cleveland iron trade. An additional furnace has been put into operation this week at the Newport Ironworks; Messrs. Dorman, Long and Co. contemplate another furnace going into blast at their Warrenby Works, and Messrs. Bolckow, Vaughan and Co. are ready to start an additional furnace when occasion demands. The Tees Furnace Company is also making preparations for an early resumption. Business has expanded considerably during the past few days, with the result that so far as the better qualities of Cleveland iron are concerned makers are unable to book orders for prompt delivery except for the lower qualities. Makers have affirmed for some time past

that there was little or no margin of profit, and now that the position has changed in their favour they have promptly advanced the prices of the better qualities by 2s. 6d. per ton. No. 1 and siliceous iron is now 97s. 6d., No. 3 G.M.B. 90s., No. 4 foundry 87s. 6d., and No. 4 forge 85s. per ton.

Hematite Pig Iron.

There are still fair stocks of East Coast hematite pig iron upon which to draw for current needs, and these will have to be disposed of before more hematite furnaces are started, but that day may not be far distant. A steady trade is being done, but only for small quantities, and makers' quotations range from 89s. to 90s. for mixed numbers, with No. 1 at a premium of 6d. per ton.

Iron-making Materials.

Business in the foreign ore trade is practically at a standstill. Consumers have all got heavy stocks, and having no need to buy, are hoping that that abstention from the market will bring prices down still further. Sellers, however, still adhere to 24s. 6d. as the price for best Rubio, c.i.f. Tees. Coke is firm at 27s. 6d. per ton for good medium furnace qualities delivered at the works.

Manufactured Iron and Steel.

There is a progressive improvement in the demand for manufactured iron and steel, but uncertainty about prices is holding up a lot of business. There is a difference between home and export quotations, a difference between the home quotations of one firm compared with those of another, and buyers have to make their own bargains with little guidance from published quotations. More orders, however, are being placed, and there is more activity at the works.

The Coal Trade.

The Northern coal market just now moves along rather quieter lines. In most directions there is a lull so far as buying is concerned, though it is hoped the present quietness is only temporary. The news from the United States of a final settlement with the anthracite miners, which thereby definitely and completely ends the coal strike there, is having an adverse effect on the Northern market, and points to the probability of no further bookings for large quantities at any rate, and may even foreshadow some cancellations, which has happened lately more than once. The inquiry from Germany is no better, probably due for the most part to the exceedingly low value of the mark and the constant violent fluctuation which makes any large buying an exceedingly risky proposition. Business is also retarded by various rumours of direct action or control of the coal imports by the German Government. The trade with France and Italy is only very moderate, which appears to be common all round, so that unless there is some rapid recovery in the European demand, the coal trade seems to be passing into a very quiet time. In the meantime the colliery position as regards prompt delivery is fairly good. Most of them are well sold for a little while ahead, but when it comes to taking the quantities out, other factors operate adversely and seriously affect the position, in individual cases causing loss of time at the pits, notwithstanding the fact that the coals are actually sold. The chief difficulty is the deadlock at the staiths and spouts, which prevents the collieries from clearing their output. The Northumberland steam coal market is very steady with the whole of the September output bespoken, and in some cases large bookings have been done for October. The Durham market, however, is by no means so favourably situated. Many of the collieries producing best and special gas coals have their books well filled for the present, but secondary gas is on offer in large quantities, and, as a rule, coking coals, together with bunkers, can be contracted for on more favourable terms than could have been done recently. The coke market remains steady for all classes of foundry and gas coke, being supported by a good demand. Prices are firmly maintained.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE tonnage launched during the month of August is the second highest for the year to date, being only exceeded by the returns for January. New orders are still very scarce, notwithstanding recent placings, and there are now very few vessels on the stocks. Launchings are far in excess of new orders, and consequently the number of unemployed is regularly added to. The Clyde tonnage for August amounted to 53,849 tons, representing seventeen vessels. Six of these were over 5000 tons each, and were as follows:—Lochgoil, twin-screw motor ship of 9500 tons, for the Royal Mail Steam Packet Company, London; a twin-screw steamer, 9000 tons, for French owners; British Merchant, geared turbine oil tanker, 7400 tons, for the British Tanker Company, London; Darian, cargo steamer, 6430 tons, for Messrs. Frederick Leyland and Co., Liverpool; Clan Macfarlane, cargo steamer, 6000 tons, for Cayzer, Irvine and Co., Glasgow; and the twin-screw geared turbine Shanghai Maru, 5400 tons, for the Nippon Yusen Kaisha, Tokyo. A notable launch during August was the twin-screw geared turbine steamer Perseus, 9500 tons, built by the Caledon Shipbuilding and Engineering Company, Limited, Dundee, for Messrs. Alfred Holt and Co., Liverpool. The Perseus is the largest vessel yet built on the East Coast of Scotland. The aggregate Clyde returns for the year to date amount to ninety vessels of 254,303 tons, compared with 165 of 299,864 tons in the same period last year. New work is very slow, but the five vessels recently placed is a hopeful move. Last week-end, too, a contract for the Clyde was reported in the shape of a new Orient liner. The Orsova and Ormonde, belonging to the same company, were built on the Clyde.

Burns and Laird Combine.

Two well-known shipping companies in Glasgow—Messrs. G. and J. Burns and the Laird Line, Limited—have become amalgamated under the title of the Burns and Laird Lines, Limited, with offices at 52, Robertson-street, Glasgow. The Burns Line originated in 1824 and the Laird Line in 1814.

New Oil Storage Installation at Aberdeen.

Of considerable interest is the inauguration at Aberdeen of an extensive storage depôt at Torry Dock, which will serve as a distributing centre in the North of Scotland for the Anglo-American Oil Company's products. An area of 2 acres is covered by the installation. Four circular tanks, providing storage accommodation for about half a million gallons—two for petroleum and two for motor spirit—and a system of piping with the requisite pumping machinery enabling the oil to be transferred to the filling department, have been laid down. Further appliances are provided whereby a 50-gallon barrel can be filled by one turn of a handle and 400 2-gallon tins can be filled in an hour without loss. There are also included departments for painting and repairing tins, caustic baths for cleaning paint off tins, and electric light appliances for discovering rust inside tins. The oil brought by the company's own steamers will be conveyed through pipes to the depôt. All the plant is of the most modern description.

Pig Iron.

Scotch pig iron continues firm in price owing to depleted stocks, but business is far from being brisk. Some export orders are reported, but local requirements remain at a very low ebb.

Steel and Iron.

The outlook in steel is a little brighter in certain directions, but there is ample room for improvement. Makers have fair orders for sections, and sheets are doing somewhat better; but there is a great dearth of new business in plates. In sheets the export demand is considerably better. Local demands for all descriptions of material are extremely slow to open up. Bar iron makers have fairly regular bookings of small lots, but nothing of much consequence is reported. Re-rolled steel bars are doing a moderate export turnover. The demand for scrap is a shade brisker.

Coal.

The Scottish coal market was firm in tone throughout the week. One or two descriptions of round coal showed a slightly easier tendency in export prices, but generally speaking firmness was the keynote. Collieries have a considerable amount of orders still on hand, and inquiries still arrive from America, though not to the same extent as recently. Business for West Italy was reported. Washed fuels continue very active, and especially in the East of Scotland are the collieries heavily engaged. Many steamers have arrived at Forth and Tay ports, and particularly at Methil. Considerable congestion is experienced and sailings are delayed. Aggregate shipments amounted to 364,219 tons against 369,522 tons in the preceding week and 358,740 tons in the same week in 1913. Prices of washed materials are firmer, and are inclined to appreciate further.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The American and Canadian Demand.

THERE is no disguising the fact that the outlook regarding the export of coal to America and Canada is now less favourable than was the case a week ago. Some owners and exporters may entertain different ideas on the subject, but the majority hold the view that the best has been seen of Transatlantic business. It is certain that the Americans will not purchase coals from this country any longer than necessity compels them to do so, and though the railway strike in that country is still in force, thus dislocating the transport and distribution of supplies, the fact remains that the strike of both the bituminous and anthracite miners is now over. Reports show that the output from the bituminous mines is already pretty extensive, resulting in buyers of similar coals from this country being only interested in practically floating cargoes. It is just possible that a certain amount of business will continue to be carried through, but the chances are that this will be mainly for anthracite and similar coals. As regards Canada, the position there is rather more favourable to further business being done, but shipments have to be made fairly quickly owing to ice troubles. At the moment collieries are busy getting away the shipments that have been arranged, but taken on the whole there is not the active inquiry coming along that is desired, and middlemen who hold supplies of coal at comparatively low contract figures are not taking any more risk than they are obliged, and are ready to discount the prices that are being quoted by the collieries direct, in order that they may get business and secure an outlet for their coals and at the same time get a fairly good profit. Continental consumers are inquiring for supplies, but this is more by way of keeping in touch with the prevailing conditions, for they are not buying on any scale. In fact, immediately they see that the market is weakening they are adopting their usual methods of holding off until they think that prices have practically touched bottom. Although the market is shorn of the firmness that has lately been in evidence, it is pretty safe to say that collieries have sufficient business on their books for a week or two to enable them to resist the fall of prices to the level that obtained immediately prior to the American and Canadian demand coming along.

Miners' Wages.

South Wales miners' wages for the current month are to remain at the minimum. This fact is disclosed by the certificate of the joint accountants. After allowing for the cost of standard wages, other costs, and the owners, standard profits of 17 per cent., the surplus available is £6566, but under clause 4 of the terms of the national agreement this surplus has to be applied in reduction of the deficiency of £56,480 brought forward from the month of June last, leaving a deficiency of £49,914 to be carried forward as a first charge to be met out of the surplus in subsequent periods. The workmen are entitled to payment of the minimum wage of 28 per cent. on the 1915 standard base rates, but the proceeds in July are not sufficient to enable the owners to pay that minimum without the sacrifice of the whole of their standard profits, plus an additional loss of £46,989. The total amount sacrificed in paying the minimum is therefore a sum of no less than £349,710. The total amount sacrificed practically since last November now amounts to a sum of not less than £2,334,000, and the whole of this sum is, under the terms of the agreement, irrecoverable. The only amount which is carried forward to future audits is the £49,914 above referred to, and this amount has been excluded from the £2,334,000. The output in July was about 330,000 tons more than in June, with the result that the cost of production other than wages showed a reduction of about 5d. per ton and the wages cost a reduction of about 4d. per ton, making a total of 9d. There was, however, a fall in the selling prices of about 5d. per ton.

Artificial Control of Prices.

Quite recently the President of the South Wales Miners' Federation, in an article on miners' wages, argued that a higher minimum wage would have compelled the coalowners in this district to obtain a higher selling price for their coal, and that unnecessary competition between them had been the cause of the fall in the prices of coal and the failure of the industry to pay a higher wage. The secretary of the South Wales Coalowners' Association has replied at considerable length, examining the position in the light of the statistics relating to the production and consumption of South Wales coal and of the relation of the South Wales supply to the world demand for and supply of coal. The fact is emphasised that South Wales is primarily an exporting district, and that it is in competition with other coal-producing countries. The history of the past few years is full of illustrations of the destructive folly of attempting to charge prices for South Wales coals which are disproportionate to the prices offered by other coal-producing countries or which are beyond the buying capacity of foreign consumers. After dealing with the relation between costs and output, the secretary of the Coalowners' Association points out that during the recent period of control minimum prices were scheduled and applied in the South Wales coalfield. Among other changes that system necessitated the classification of collieries according to the coal they produced. The result was that a demoralising artificial direction was given to the distribution of trade and to the working of the collieries; some collieries could only be kept working two or three days per week, while others were kept in regular employment for five or six days per week. The dissatisfaction of the workmen with these results of an artificial interference with the conduct of the trade was as intense as that of colliery owners and coal exporters, who found themselves hopelessly handicapped. That experience simply confirmed previous experience in the application of artificial systems in the regulation of trade, and if they were resented by the workmen in the past they will be certainly no less strongly resented by them in the future.

Ebbw Vale Troubles.

The miners at the Ebbw Vale group of collieries resumed work on Monday last following on the negotiations between the Ebbw Vale Company's chief officials and Mr. Evan Davies with other miners' leaders, but judging from the tone of the speech of Mr. Evan Davies at a mass meeting of the workmen when they adopted his advice to resume work, it is not possible to believe that an end of the trouble has been seen. There may be unfavourable developments yet. The 200 fitters, boilermakers and smiths at the Ebbw Vale works are still on strike owing to the introduction of a new card system, and there has been a mass meeting of members of the allied skilled trades to consider their attitude towards the matter. Resolutions were passed at previous meetings that action should be taken immediately to join the men already out of work, but on advice the men agreed that they would not put this resolution into operation until further efforts have been made to get their grievances remedied by the management. In the event of a refusal the previous resolution will be put into force.

Current Business.

The steam coal market is certainly quieter since writing a week ago, and there is scarcely a colliery producing the best Admiralty coal which is quoting more than 30s. per ton, while for forward some of them are discounting this figure by a shilling a ton. There is no doubt that they would be glad to get business at this price, but buyers are comparatively few and middlemen are prepared to accept even less in order to find an outlet for their contract coals. Monmouthshire coals are on the weak side, and are not worth more than 28s. 6d. at the best, and can be obtained at less. One firm is reported to have sold about 10,000 tons of Monmouthshire large for the Dutch State Railways at the price of round about 30s. c.i.f. It is reported that inquiries are in the market for supplies of coal, chiefly coking smalls, for Germany, but collieries are not greatly interested in view of the uncertain financial conditions prevailing. Small coals are easier, but dry coals are comparatively steady for shipment this month, as they are pretty fully booked up. Anthracite coals are also very firm, and it is still a difficult matter to get offers of any substantial quantity for delivery this month, especially sized coals, which, in the case of nuts and cobbles, range from 72s. 6d. to 75s.

Swansea Metal Exchange.

Dulness rather characterises the Welsh tin-plate market, the adverse conditions of foreign exchanges restricting operations on continental account. A certain amount of business is reported for Canada, but the market is no more than steady at 19s. to 19s. 3d. basis I.C. f.o.b.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	22/6
(1) Spanish	22/6
(1) N. African	22/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	24/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 7 6	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. COAST—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 0 6	5 0 6
Cleveland—		
No. 1	4 17 6	4 17 6
Silicious Iron	4 17 6	4 17 6
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 4 0	—
(3) Northampton—		
Foundry No. 3	4 0 0	—
,, Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 6 6	—
Forge	4 2 6	—
(3) Lincolnshire—		
Basic	4 6 6	
Foundry	4 6 6	
Forge	4 6 6	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 5 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	11 0 0	—
Tees	10 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 10 0 to 11 0 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 9 17 6	
Gas Tube Strip	11 0 0 to 11 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	12 10 0	—
Ship Plates ½in. and up	9 0 0	—
Sections	8 15 0	—
Steel Sheets ⅛in. to ½in.	10 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 12 6

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 0 0	—
Angles	8 15 0	—
Boiler Plates	12 10 0	—
Joists	9 0 0	—
Heavy Rails	9 10 0	—
Fish-plates	13 10 0	—
Channels	13 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	9 0 0 to 9 10 0	
,, (others)	9 10 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 0 0 to 10 0 0	
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 5 0	—
Hoops	12 5 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Billets and Sheet-bars	7 0 0 to 7 2 6	
Gas Tube Strip	10 0 0 to 10 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	16 15 0	—
Angles	8 15 0 to 9 0 0	
Joists	9 0 0 to 9 10 0	
Tees	10 0 0	—
Bridge and Tank Plates	9 0 0 to 9 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/- to 19/3
Block Tin (cash)	159 10 0
,, (three months)	159 17 6
Copper (cash)	63 0 0
,, (three months)	63 7 6
Spanish Lead (cash)	24 5 0
,, (three months)	23 10 0
Spelter (cash)	31 5 0
,, (three months)	30 10 0
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
,, Electrolytic	70 10 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	25 10 0
,, Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/9½ per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24	10/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£23 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£60	26/-
,, 1 p.c. ,,	£70	30/-
,, 0·75 p.c. carbon	£75	37 -
,, carbon free	1/7 per lb.	
Metallic Chromium	5/- per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale unit	5/- per
,, ,, 75 p.c.	23 10 0 sca'e unit	6/- per
,, Vanadium	18/- per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	22/-
,, ,, Ell	23/-
,, ,, Splint	21/- to 25/6
,, ,, Trebles	23/-
,, ,, Doubles	22/-
,, ,, Singles	21/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	22/-
,, ,, Splint	23/-
,, ,, Trebles	23/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	22/- to 25/-
Screened Navigation	30/-
Trebles	23/6
Doubles	22/6
Singles	21/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	23/-
Secondary Steam	22/-
Trebles	23/6
Doubles	22/6
Singles	21/6

ENGLAND.

(8) N.W. COAST—	
Steams	30/-
Household	46/8 to 57/6
Coke	33/-
NORTHUMBERLAND—	
Best Steams	25/-
Second Steams	23/- to 24/-
Steam Smalls	17/- to 18/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	24/- to 25/-
Second	21/- to 22/6
Household	25/- to 28/-
Foundry Coke	33/- to 35/-
SHEFFIELD— INLAND.	
S. Yorks. Best Steam Hards	21/- to 22/-
Derbyshire Hards	19/- to 20/-
Seconds	18/- to 20/-
Cobbles	17/- to 19/-
Nuts	15/- to 16/-
Washed Smalls	10/- to 11/-
Best Hard Slacks	12/- to 13/-
Seconds ,,	9/- to 10/6
Soft Nutty ,,	7/6 to 8/6
Pea ,,	7/- to 8/-
Small ,,	2/- to 4/6
House, Branch	30/- to 33/-
,, Best Silkstone	27/6 to 29/-
Blast Furnace Coke (Inland and Export)	20/- to 30/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	29/6 to 30/-
Second ,, ,,	28/- to 29/6
Best Dry Large	30/- to 31/-
Ordinary Dry Large	29/- to 30/-
Best Black Vein Large	27/6 to 28/6
Western Valley ,,	27/- to 28/-
Best Eastern Valley Large	26/6 to 27/6
Ordinary ,, ,,	24/6 to 25/-
Best Steam Smalls	19/- to 20/-
Ordinary ,,	17/6 to 19/-
Washed Nuts	30/- to 35/-
No. 3 Rhondda Large	30/- to 31/-
,, ,, Smalls	22/- to 23/-
No. 2 ,, Large	23/6 to 24/6
,, ,, Through	21/6 to 22/-
,, ,, Smalls	16/- to 17/-
Coke (export)	40/- to 42/6
Patent Fuel	27/- to 30/-
Pitwood (ex ship)	28/- to 30/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	62/6 to 65/-
Seconds	55/- to 60/-
Red Vein	52/6 to 55/-
Machine-made Cobbles	72/6 to 75/-
Nuts	72/6 to 75/-
Beans	45/- to 50/-
Peas	24/- to 25/-
Breaker Duff	8/6 to 9/-
Rubbly Culm	15/- to 15/6
Steam Coals:	
Large	25/- to 27/6
Seconds	24/- to 25/-
Smalls	14/6 to 16/-
Cargo Through	19/6 to 22/6

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Iron Ore and Coke.

ONE of the causes of the economic troubles of Germany is the loss of the iron ore deposits of Lorraine, which has left her utterly dependent upon foreign sources of supply. Even before the war the Lorraine iron ore mines were not producing sufficient for home requirements, and Germany had cast a longing eye upon the rich Briey mineral deposits, which would have provided all the iron ore she needed. Now that Germany has lost everything she is endeavouring to cover her requirements in iron ore partly from Sweden and more especially from Canada. Under present conditions those sources of supply are evidently not economical to German consumers, who would have every advantage in purchasing French minerals, as they are already doing to a large extent. But as the French are reluctant to supply iron ore to Germany, consumers in that country cannot depend upon future supplies. On the other hand, France is unable to make adequate use of her mineral deposits in the absence of coke, which can only be obtained from Germany, and although the Versailles Treaty provided for a certain supply of coke to France, the quantity forthcoming is nevertheless so small that efforts are being made to improve the quality of coke from the Saar district by means of new processes which are said to be giving promising results. It was partly with the idea of procuring ample supplies of good coke that the French were so anxious to obtain control over the Ruhr basin. Seeing that both countries are dependent on each other for raw material, it is reported here that feeling is growing in Germany in favour of the proposed Allied participation in German industries; but whatever may be the basis of an understanding between the two countries, it is clear that something must be done to facilitate an interchange of iron ore and coke.

Marine Charts.

The sinking of the battleship France through the ripping open of the hull by uncharted rocks while she was proceeding slowly along the Teignouse passage into Quiberon Bay has naturally brought the Hydrographic Department of the Marine under severe criticism. The explanation that the battleship must have struck some unknown rocks was at first received with scepticism, as it appeared almost impossible that such obstacles in home waters should have escaped detection. Divers, however, reported that the rocks existed, and that the top of one had been broken off by the impact. On behalf of the Hydrographic Department of the Marine it is explained that by the usual method of taking soundings it is quite possible to miss isolated rocks emerging from the sea bed, and it is stated that the only way to locate them is to draw a hawser along the bottom, which is to be done now that the disaster to the France has shown the necessity of verifying the charts of the particularly rocky coast of Brittany. The France was a super-Dreadnought of 28,500 tons, launched in 1912, and, except for the Béarn, which is not yet in commission, was the most powerful unit in the French navy. A preliminary investigation by experts shows that the re-floating of the battleship will be a very expensive operation, even if it can be done successfully, and in the event of the vessel being regarded as a total loss it is believed that the Government has no intention of replacing it, although the question of bringing the tonnage of capital ships up to the limit allowed by the Washington Conference can only be settled when the new programme of naval construction comes up for discussion.

Moving Platforms.

About thirty competitors, including four foreigners, have sent in plans for an underground moving platform which it is proposed to install experimentally under the Avenue de l'Opéra with a view of solving the increasingly difficult traffic problem in Paris. As others appear to be holding aloof for fear that their ideas may be plagiarised, it is pointed out that all plans of new inventions submitted are accorded the advantage of temporary protection; that is to say, the owner of a project enjoys the rights of a patentee until he applies for a patent, which, in this case, would enable him presumably to delay going to the expense of patent formalities pending the acceptance or otherwise of his scheme. The last date for sending in projects is September 20th next. If the Commission, which is to be appointed shortly by the Prefect of the Seine, is able to select a scheme likely to give satisfactory results it will be executed experimentally by the Municipal Council, and in the event of its being adopted the inventor will be offered a million francs for his rights. One of the conditions laid down is that the moving platform must be quite silent.

The Havre Strike.

The revolutionary character of the strike at Havre was made perfectly clear during the week by the conflict with the police in the town itself and by the efforts of the Confédération Générale du Travail to organise a twenty-four hours' sympathetic strike throughout the country. As the engineering firms at Havre refused to take back the men at the old wages the local unions declared a strike throughout the district, and work was suspended everywhere. The strike was only made effective by aggressive picketing, which necessitated the intervention of the police, when barricades were raised and fighting was at times serious. The movement was entirely Communist, the object being to deprive employers of any right to reduce wages and to impose the unions' control over the works' management, and the Confédération Générale du Travail hoped to enforce that principle by a national strike of twenty-four hours. The demonstration failed so completely that in only a few cases was there any serious interruption to business.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

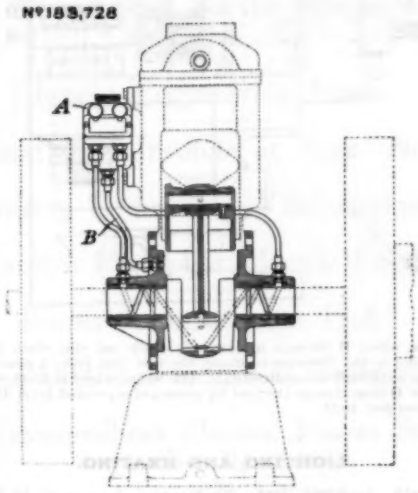
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

183,728. August 23rd, 1921.—LUBRICATING TWO-STROKE ENGINES, P. W. Petter, West Park House, Yeovil, and Petters Limited, Nautilus Works, Yeovil.

WITH this system of lubrication the main bearings of the engine are supplied with oil from lubricating box A, which is connected with the crank chamber through the pipe B and a non-return valve, so that it is subject to the compression pressure. The oil

Nº183,728



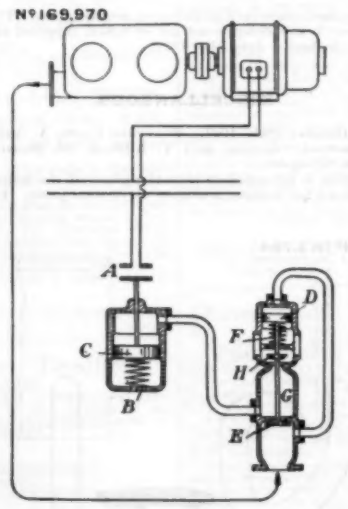
passes along the bearings through helical grooves and through the crank pin and thence up the connecting-rod to the gudgeon pin. A pinhole is provided in the air space of the lubricator to dissipate the pressure when the engine stops, while sight feeds are arranged in the oil pipes.—*August 3rd*, 1922.

SWITCHGEAR.

169,970. October 9th, 1920.—DEVICES FOR THE AUTOMATIC OPERATION OF AN ELECTRIC CIRCUIT BREAKER CONTROLLED BY THE PRESSURE OF A MOVABLE MEDIUM. The Oerlikon Company, of Oerlikon, near Zürich, Switzerland.

This specification describes a method of automatically starting and stopping a motor driving an air compressor. As long as there is no compressed air the circuit breaker A is maintained in the closed position by the spring B. If the compressor is started, however, the compressed air acts upon the piston C and on the disc D. The surface of the latter is made larger than that of the valve E, and when the maximum air pressure is attained the force upon the piston D overcomes the pressure on the valve E and also the force exerted by the spring F. As soon as the valve E is opened compressed air enters the chamber G. A second valve H is provided and has a smaller diameter than the valve E. The excess air pressure which is produced in the chamber G

Nº169,970



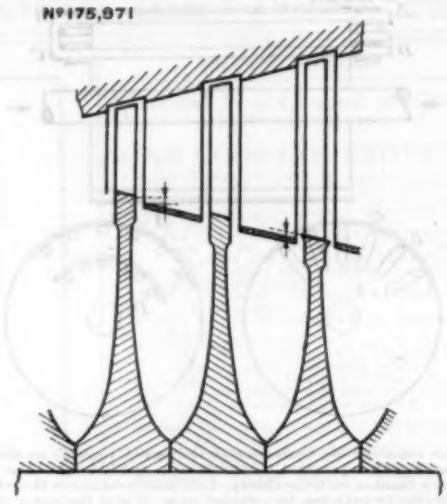
partly releases the valve E so that the overbalance of force upon the piston D rapidly increases and causes the valve H to be closed instantaneously. During this very brief operation the air pressure above the piston C is also increased so that the spring B is compressed, and at the same time the circuit breaker A is opened and the compressor is stopped. As soon as the air pressure falls to a predetermined minimum the force of the spring F, assisted by the pressure of the air in the chamber G, acting upon the valve H, predominates over the air pressure above the piston D, thus opening the valve H and closing the valve E. The air above the piston C then escapes through the valve H and the spring B closes the circuit breaker, thus causing the compressor motor to start.—*August 3rd*, 1922.

TURBINE MACHINERY.

175,971. February 14th, 1922.—STEAM TURBINE ROTOR DISCS, Aktiengesellschaft Brown Boveri et Cie., Baden, Switzerland.

The inventors propose to relieve the rotor discs of reaction turbines from axial thrust by so arranging the guide blades that the jet of steam issuing from the moving blades has free access to the guide blades, but on issuing therefrom partially encounters

Nº175,971

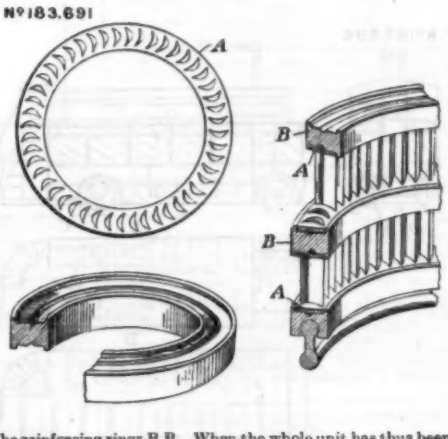


the disc of the next wheel. This is effected by making the guide blades project, as shown, beyond the roots of the moving blades. It is claimed that the steam thus intercepted gives up some of its energy in pressure form and that this pressure can be utilised to relieve the discs.—*August 3rd*, 1922.

183,691. July 6th, 1921.—RADIAL FLOW STEAM TURBINE WHEELS, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

According to this invention the blade ring for a radial flow turbine is built up by inserting the ends of the blades in comparatively thin punched plates A, which are gripped in grooves

Nº183,691



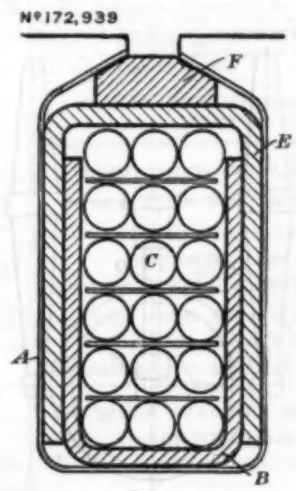
in the reinforcing rings B B. When the whole unit has thus been built up the several parts are firmly fixed by a fusion process, such as brazing.—*August 3rd*, 1922.

DYNAMOS AND MOTORS.

172,939. December 16th, 1920.—IMPROVEMENTS IN THE HIGH-VOLTAGE SLOT WINDINGS OF ELECTRICAL MACHINES AND THE PROCESS FOR THE MANUFACTURE OF THE SAME, Brown, Boveri and Cie., Baden, Switzerland.

The slots are first lined with an insulation layer A, and the lower U-shaped insulating channel B is placed in the slot before the introduction of the coil C. The coil in its formed condition is introduced laterally wire by wire through the slot opening and

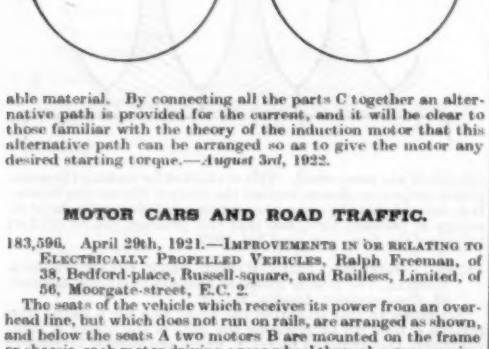
Nº172,939



the layers are insulated from one another in the manner shown. The U-shaped channel E is then slipped over the coil in the axial direction, and finally a wedge F is driven in at the top of the coil. —*August 3rd*, 1922.

183,612. May 6th, 1921.—IMPROVEMENTS IN ALTERNATING-CURRENT MOTORS, Dewhurst and Partners, Limited, of 28, Hatton-garden, and Melbourne Dewhurst, of the same address.

The rotor conductors A B and C D are led through the rotor in close proximity to the periphery and return to the point D by way of slots. All the ends A are connected together and also all the ends D. The parts B and C may be joined by any suit-

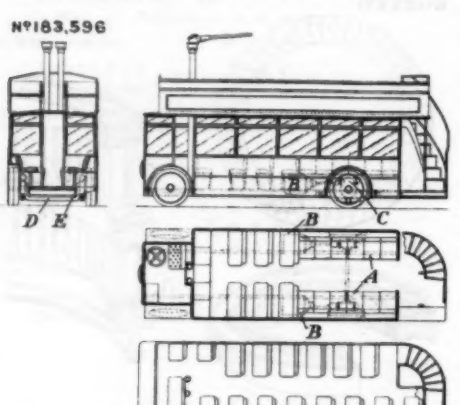


able material. By connecting all the parts C together an alternative path is provided for the current, and it will be clear to those familiar with the theory of the induction motor that this alternative path can be arranged so as to give the motor any desired starting torque.—*August 3rd*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

183,596. April 29th, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTRICALLY PROPELLED VEHICLES, Ralph Freeman, of 38, Bedford-place, Russell-square, and Railless, Limited, of 56, Moorgate-street, E.C. 2.

The seats of the vehicle which receives its power from an overhead line, but which does not run on rails, are arranged as shown, and below the seats A two motors B are mounted on the frame or chassis, each motor driving a rear wheel through worm gearing C. The motors and driving shafts are slightly inclined. The

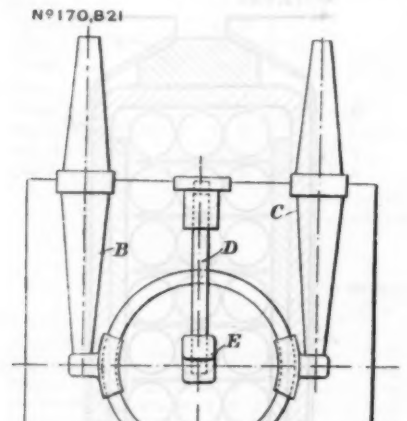


axle D of the rear wheel is U-shaped and the horizontal portion is near the ground. Immediately above this dropped portion of the main axle is the frame E, which supports the floor which forms a well between the seats. The object of the invention is to provide a low centre of gravity, the total height of the vehicle being relatively small.—*July 31st*, 1922.

TRANSFORMERS AND CONVERTERS.

170,821. April 28th, 1921.—IMPROVEMENTS IN OR RELATING TO ELECTRIC TRANSFORMERS, La Metallurgique Electrique, of 14, Rue Taitbout, Paris.

This invention relates to a high-voltage transformer com-

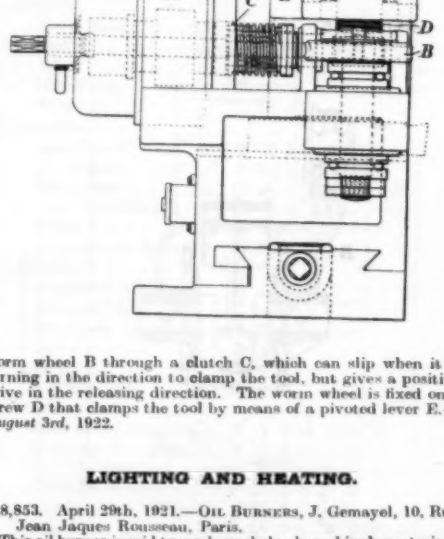


prising circular frames supported at right angles to each other and of such dimensions that the distance between any point of one frame and any point on the other is sufficient to prevent a discharge across the dielectric. The frame A constitutes the primary and is supported in an oil tank in the manner shown, the high-tension cables passing through the hollow columns B and C. At right angles to the frame A is another frame D composed of magnetic material and having the same dimensions as the other frame. At the bottom of the frame D is a winding E which forms the secondary.—*July 28th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

183,693. July 8th, 1921.—TOOL HOLDERS FOR LARGE LATHES, H. Sutton, Beamsmoor, Marple, Cheshire, and Sir W. G. Armstrong, Whitworth and Co., Limited, Elswick Works, Newcastle-on-Tyne.

In order to relieve the operator of the effort necessary to clamp the tool in its rest on large lathes, the inventors effect the clamping by means of an electric motor A. This motor operates the

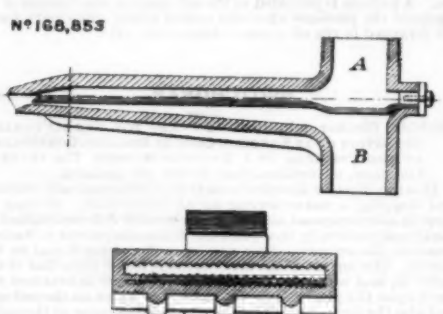


worm wheel B through a clutch C, which can slip when it is turning in the direction to clamp the tool, but gives a positive drive in the releasing direction. The worm wheel is fixed on a screw D that clamps the tool by means of a pivoted lever E.—*August 3rd*, 1922.

LIGHTING AND HEATING.

168,853. April 29th, 1921.—OIL BURNERS, J. Gemayel, 10, Rue Jean Jaques Rousseau, Paris.

This oil burner is said to work smokelessly and is characterised by the fact that the orifices have a wavy cross section as shown.

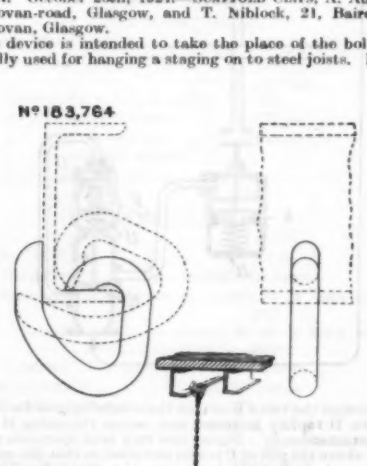


Otherwise the burner is of well-known construction. The oil is admitted at A and compressed air or steam supplied at B for atomising the fuel.—*July 31st*, 1922.

MISCELLANEOUS.

183,764. October 28th, 1921.—SCAFFOLD CLIPS, A. Auld, 867, Govan-road, Glasgow, and T. Niblock, 21, Baird-street, Govan, Glasgow.

This device is intended to take the place of the bolted clip generally used for hanging a staging on to steel joists. Its form



and mode of application are so obvious in the drawings as to need no description.—*August 3rd*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TUESDAY TO FRIDAY, SEPTEMBER 5TH TO 8TH.

IRON AND STEEL INSTITUTE.—Autumn meeting at York. For programme see page 96.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 6TH TO 13TH.

BRITISH ASSOCIATION.—Meeting at Hull.

TUESDAY, SEPTEMBER 12TH.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED.—85–88, The Minories, Tower-hill, E. Presidential address by Sir George G. Goodwin. 6.30 p.m.

WEDNESDAY, SEPTEMBER 13TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—Visit to the carriage and wagon works of the Great Central Railway at Dukinfield. Members will meet at London-road Station, G.C.R., and leave by special train at 2.30 p.m.

SATURDAY, SEPTEMBER 16TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Eastern District meeting at Luton. London members will leave St. Pancras by the 9.25 a.m. train.

TUESDAY TO FRIDAY, SEPTEMBER 19TH TO 22ND.

THE INSTITUTE OF METALS.—Swansea. Annual autumn meeting. For programme, see page 152.

LAUNCHES AND TRIAL TRIPS.

LOCHGOIL; twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of the Royal Mail Steam Packet Company; dimensions, 502ft. by 62ft. by 38ft. 6in.; to carry 9500 gross tonnage. Engines, two eight-cylinder four-cycle Diesel oil, 6000 indicated horse-power; constructed by the builders; launch, August 24th, 1922.

BRITISH SCOUT; tank steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the British Tanker Company, Limited; dimensions, 245ft. by 37ft. beam; to carry 2000 tons of oil cargo. Engines, triple expansion; constructed by the builders; launch, August 25th, 1922.

BRITISH GENERAL, geared turbine oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Limited; to the order of the British Tanker Company, Limited; dimensions, 440ft. by 57ft. by 33ft. 11in.; to carry 10,200 tons deadweight. Engines, single-screw double-reduction geared turbines, pressure 200 lb. per square inch; constructed by the builders; trial trip, August 28th, 1922.

A FLOATING caisson, built to the order of the Port of London Authority for its dry dock at Millwall Docks, was launched by Swan, Hunter and Wigham Richardson, Limited, on August 29th. The size of the caisson, designed to float at a draught of about 19ft. 10in., is approximately 68ft. 10in. by 20ft. 10in. by 32ft. 8in.

SPIRILLA, oil tanker; built by Swan, Hunter and Wigham Richardson, Limited; to the order of the Anglo-Saxon Petroleum Company, Limited; dimensions, 427ft. by 53ft. 4in. by 31ft.; to carry 8370 tons deadweight. Engines, single-screw; constructed by the Wallsend Slipway and Engineering Company, Limited; trial trip, August 31st, 1922.

BILERDYK; built by Harland and Wolff, Limited; to the order of the Holland-America Line; dimensions, 400ft. by 54ft. by 31ft.; to carry 6800 tons gross. Engines, Brown-Curtis turbines, developing 3000 horse-power; constructed by the builders; handed to owners, August 31st, 1922.

SAN ROSENDO, tank steamer; built by Armstrong, Whitworth and Co., Limited, to the order of the Eagle Oil Transport Company, Limited; dimensions, 420ft. 6in. by 52ft. by 31ft. 6in.; to carry 8250 tons. Engines, triple-expansion, marine type, 27in., 45in., 75in. by 48in. stroke, pressure 180 lb.; constructed by the Wallsend Slipway and Engineering Company, Limited.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. BERTRAM C. JOY and Mr. T. Crespin Harrison inform us that they have started business as consulting engineers, under the title of Joy and Harrison, at 168, Regent-street, London, W. They intend to specialise upon, among other subjects, the development of mechanical invention, the production of drawings and demonstration models, and the working out in detail and the undertaking of the manufacture of inventions.

CONTRACTS.—An important order has been placed by Sir Ganga Ram, C.I.E., M.V.O., who is at present in this country, with Vickers Limited for water turbines and electrical plant, in connection with the development of power from a low head fall on the Bari Doab Canal in the Punjab. The head which will be utilised is only 6ft., and the total power obtained will be 1925 horse-power. The energy will be transmitted to various pumping stations where irrigation water will be raised, thereby enabling larger areas of good land to be cultivated.

LEICESTER TECHNICAL SCHOOL.—At the invitation of the Brush Electrical Engineering Company, Limited, Loughborough, a party of students from the Leicester Technical School paid a visit to the works on Friday, September 1st. Considerable interest was taken in the Brush-Ljungstrom steam turbine and the turbo-generator sets, several of which were inspected in various stages of manufacture; a feature of notable interest being a 5000-kilowatt Brush-Ljungstrom turbo set which was undergoing final test. In the tramways and rolling stock departments, the extensive shops and up-to-date manufacturing methods employed in the production of all classes of road and rail transport were studied with great interest. A special feature noticed was the attention now being given to the development of the trackless trolley-bus, which, for new systems is replacing the tramcar, owing to the high cost of track construction and renewal. A large number of these vehicles are at present under construction for the Bloemfontein tramways. The transformer department was found to be very busy, and the various new features and innovations claimed the close attention of the visitors. At the conclusion of the tour of inspection, tea was provided by the directors, after which a few words of welcome by Mr. Brotherton, the works manager, were acknowledged by a hearty vote of thanks by Mr. Taylor, head of the engineering department of the Leicester Technical School.